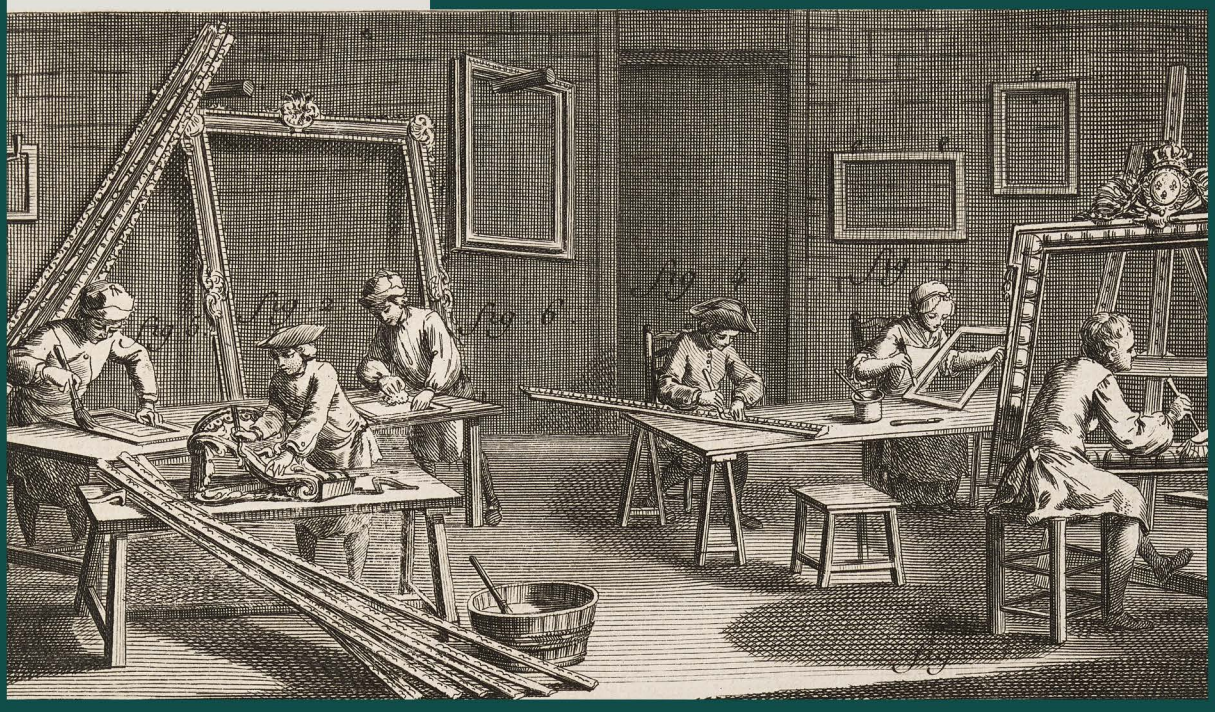
Gilding Notes

The Traditional English Method

Guidelines



Judith Wetherall

Getty
Conservation
Institute

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Los Angeles

Gilding Notes: The Traditional English Method by Judith Wetherall

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The Getty Conservation Institute (GCI) works internationally to advance conservation practice in the visual arts—broadly interpreted to include objects, collections, architecture, and sites. The Institute serves the conservation community through scientific research, education and training, field projects, and the dissemination of information. In all its endeavors, the GCI creates and delivers knowledge that contributes to the conservation of the world's cultural heritage.

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Cover: The successive stages of gilding on wood (left to right): bleaching (fig. 5), repair (fig. 2), sanding (fig. 6), softening (fig. 4), vermilioning (fig. 1), and easel gilding (fig. 3). From "Le Doreur sur bois," *Illustrations de l'Encyclopédie ou dictionnaire raisonné des sciences, arts et métiers* by Denis Diderot, Jean Le Rond d'Alembert, and Bénard, 1777–1779. Courtesy of the Getty Research Institute, Los Angeles (84-B31322).
P. 50: From "Le Doreur sur bois."

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Foreword

Gilding Notes: The Traditional English Method is published under the auspices of the Getty Conservation Institute's Cleaning of Gilded Wooden Surfaces project, which aims at addressing the challenges presented by the cleaning of wooden gilded surfaces and at identifying appropriate treatment options. At the start of the project, in March 2018, the Getty Conservation Institute (GCI) organized and hosted an experts meeting at the Getty Center in Los Angeles, bringing together specialists of gilded surfaces from around the world. The author of this publication, Judith Wetherall, was one of the invited participants, arriving from the United Kingdom.

During her more than forty years of work experience as a gilder, Wetherall has had the opportunity to interact with a multitude of gilded artifacts, studying them and, in doing so, connecting with their creators. This intimacy with the objects on which she has worked has guided her approach to preserving them through a deep understanding of their materiality and history but has also inspired her own creations. Among Wetherall's preeminent qualities is her insatiable passion for anything gilded, and for sharing her extensive knowledge with students and experienced gilders alike. In prelude to her retirement, this publication represents a part of her legacy.

It is thus with delight that the GCI publishes for the first time what Wetherall calls her "gilding notes," here in their ninth edition, developed all along her career as an instructor. It was decided to share these notes with the field in their original format in order to preserve Wetherall's original intent: to guide students, gilders, and conservators in their understanding of the manufacture and conservation of wooden gilded surfaces. Editing was limited to minor changes to enhance the notes' clarity and make them conform to Getty and US conventions. Readers will enjoy Wetherall's enthusiasm as they navigate various aspects of the manufacture and conservation of wooden gilded objects. This does not aim to be a formal academic publication, but rather a practical tool.

While English gilded surfaces are the focus of this volume, it will be useful to anyone interested in gilded wood and will complement other GCI publications developed as part of the Cleaning of Gilded Wooden Surfaces project.

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GCI Senior Project Specialist
Los Angeles

FIGURE 1 Gilded-wood bench, by designer Thomas Hope, British. Dated before 1807. Gilded mahogany, modern wool cover and silk trim.

Introduction: Gilding Art and Use

The author originally devised these notes as a teaching aid for practical application. Gilding is a vast and exciting subject, the intricacies of which cannot be encompassed in a written document such as this. The subject deserves much more consideration and depth than can be conveyed here. Integral to gilders' methods, materials, and techniques is that practitioners will use their own chosen materials and handling preferences. However, providing that the ethos, methods, and craft of professional gilding are understood and employed, the variations in gilders' practices may achieve good, stable results with different but successful treatments.

Gilding methods and materials vary from region to region across the world. The gilding materials and techniques described thousands of years ago in the Old Testament or seen in the ancient Egyptian hieroglyphs are still valid today. The variety of materials and techniques has evolved predominantly due to local geology and, accordingly, the sourcing and availability of local materials. Also affecting change were the vagaries of gilding craftsmen employing bespoke tools, reflecting the regional development of historic ornament styles and the use of gilding within those design eras.

These notes are intended as a theoretical and briefly historical foil to the practical elements of traditional, professional gilding. Predominantly English methods and techniques are described. This guide allows interested students to engage with materials and processes with an instinctive, craftsman-like sensitivity. Practice is imperative. Through practice, gilding may be better understood as the complex and time-consuming craft that it is, but above all the intention is to make the craft of gilding accessible, exciting, and richly rewarding.

The original purpose of gilding was to give an object the appearance of solid gold. By applying a thin covering of gold onto a prepared surface, the appearance of solid gold was achieved without the expense, weight, or working techniques of using the solid metal.

The art of gilding has changed little since Antiquity—it is reputed to be one of the oldest professions in history. Ancient Egyptians applied thick beaten gold onto wooden surfaces to emulate a solid gold object.

Among Tutankhamun's treasures are numerous examples of gilded objects, such as polychromed statues and decorative panels, all using beaten gold to imitate the solid article. There are also some fine examples of much later furniture (notably from India, in the collection of London's Victoria and Albert Museum) in which very thick sheets of gold were tacked, and not laid as leaf, onto the wooden substrate.

Gold has also been used for decorative purposes, to enhance surfaces and stone or wood carving, intensifying the natural beauty of the various substrates' core materials. The gilded wood bench illustrated here, by British designer Thomas Hope, illustrates the influence of Hope's archeological taste in the early nineteenth century, and the use of gold leaf to produce a refined piece of furnishing in which the carved gilded wood resembles solid metal (fig. 1). The ancient Greeks painted and gilded exterior architecture, not only to enrich the surfaces, but also to impart a sense of power and wealth. The same is true throughout the history of applied ornament anywhere: gold symbolizes wealth, beauty, value, and power.

Gold has always been held in high esteem in the decoration of artifacts. Its malleability is a result of its specific atomic deformation during beating. Its inert nature as an element and its mysterious visual impact have all ensured its continuing survival and use. No other material behaves like it: it is unique.

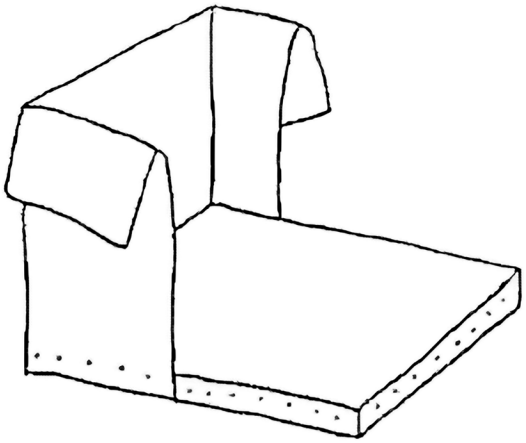

FIGURE 2A A **gilder's cushion (pad)** provides the surface upon which gold/silver leaf is cut. It has a smooth, dead-flat calfskin suede working-surface on a felt/velvet layer, over wood. A parchment back shield can endure frequent folding, is not static, and does not attract grease, which could harm the gold handling. Leather straps are attached underneath for a thumb and forefinger when gilding standing up.

FIGURE 2B A **gilder's knife** is used for handling and cutting the leaf. Straight, long-bladed, and balanced with angled end (not rounded). It should never get wet. Historically, the end of the handle was drilled and packed with lead so that the knife would be held away from the bench if put down (resting on the shoulders of the ferrule), thus protecting the blade from damp and grease.

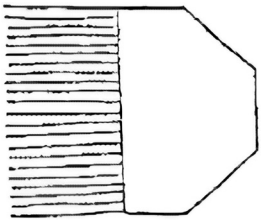

FIGURE 2C A **gilder's tip** is made of animal hair, the best being of squirrel (badger available but often too stiff and tears gold easily.) Set in cardboard, it is used flat to pick up the leaf from the cushion, to lay on the object. "Medium" is a common thickness and length. It is the width of gold leaf (3.25"). The hair should not be cut: the gold can be picked up from any area of the tip width. Gilder's tips are sometimes used for "tamping" down the gold after gilding, but this shortens the life of the tip. Instead, use a sable "writer" (fig. 2e) to tamp.

FIGURE 2D A **gilder's mop** is a large, round, squirrel-hair brush originally set in quill, used for wetting the gilding area (do not use ordinary metal-ferruled brushes). It is designed to hold a quantity of size water and come to a stable point. Earlier mops set in bird quills were named for size accordingly (swan, goose, etc.). Quill-mounted mops were attached to wooden brush handles by steaming to soften the quills, then pushed on, hardening upon cooling.

FIGURE 2E A **writer** is a sable round, chisel-ended (the natural end of the hair, not cut flat which would tear the gold). Mounted on the other end of the mop handle, it gives a wet and a dry ended brush. It is used for "faulting" and tamping down gold leaf. It is always used dry, gently tamping end-on.

FIGURE 2F A **burnisher** is a polished agate stone mounted on a wooden handle. Historically also made of hematite, or earlier, of wolves' teeth. It is used to burnish gilding by employing controlled pressure at a specific drying point after laying the leaf. Dog's tooth shape is common for general use. "Pencil" and book-edge shapes are also available.

FIGURE 2G Gesso hooks or woodcarving tools are used to cut textures and designs in the applied, dry, or re-wetted gesso prior to applying bole and gold. Hooks are used drawn towards oneself whereas carving tools are pushed away (both of different edge-sharpened shapes).

GILDERS' TOOLS

Brushes

Traditionally, brushes were made with hogs' hair for gesso application; squirrel for size water application, picking up gold leaf, and often tamping the gold after laying; and sable for finer, detailed work. Many other options are available now, and practitioners will have their own preferences. The choice of brushes for applying the gilding preparation material (gesso) is entirely the prerogative of the individual. However, as a guide, a selection of round ox hair brushes, flat hogs' hair bristle brushes (½–1 in.), and flat ox hair or sable brushes will suffice. (Sable is expensive and will be embrittled by the gesso if not conditioned.) Synthetic (nylon) brushes do not hold much volume of the liquid gesso (they were designed to lay acrylic paint in smooth, thin layers), but flat synthetics can be used to apply very thin layers of gesso if chosen. Brushes should be long. Round, string-bound hogs' hair brushes can also be used to stipple on gesso. It is more common to apply gesso using hogs' hair brushes held flat in England, while round, string-bound hogs' hair for stippling gesso end-on is more commonly used abroad.

Vessels

Gesso was traditionally made in a "pipkin," a handled earthenware vessel with straight sides and a glazed interior, and with a capacity of up to approximately one pint. The pipkin was heated up in boiling water in a bain-marie and then maintained at an even, gentle heat ideal for gesso. Historically, vessels were never metal because metal's heat conductivity resulted in the gesso heating or cooling too quickly, resulting in gesso thickening, skin, or bubbles. Historic metals were also mainly composed of ferrous materials, which rusted easily in contact with the water-based gilding preparation materials, contaminating the pure, white gesso and rendering the gesso gilding ground useless. Even with stable metals available today, extremes of thermal conductivity can make the gesso unusable, so metal containers should not be used.

Ideally, gesso should be made in a straight-sided vessel of glass, Pyrex, or glazed pottery, no smaller than a pint or half a liter capacity in volume. Appropriately labeled large white mugs are suitable for smaller gesso quantities, but gesso needs to be kept at a constant, even temperature, and smaller vessels tend to heat and cool too quickly, which can again result in gesso bubbles, thickening, or a skin. Labeled mugs, which should be white, are ideal for bole (see "Bole") as the bole color must be evaluated during its making. Historically, pipkins were used throughout the entire preparation process.

Sticks and Tights

Flat stirring sticks are essential for gesso and bole, preferably wooden—but not metal—spoons as metal will heat and cool the materials too quickly. Wooden tongue depressors or similar are excellent. The liquid

gesso's resistance needs to be felt against the flatness of the stick, to indicate the chosen gesso type's ideal nature for the task. In gesso making, the proportion of chalk whiting to rabbit-skin glue is judged by its consistency, evaluated through resistance while stirring. During application, the gesso consistency is measured by stirring with the flat stick, which will indicate the gesso's ability to flow under the brush, helpful for gesso application using varying brush-handling techniques in specific areas. Slow stirring is also fundamental to keep the gesso temperature evenly distributed in the vessel, to avoid introducing air bubbles, and to prevent a skin forming as a skin may contaminate the gesso and produce lumps during the gesso-laying process.

After combining chalk whiting and rabbit-skin glue in making gesso and testing for proportional consistency, traditionally the gesso was strained through linen before its application. It is now easier and more efficient to strain using a double thickness of nylon tights or a similar material stretched over the clean vessel.

Smoothing Tools and Materials

To smooth gesso after application and drying, small metal plates with a burr on one edge were traditionally used on gessoed panels or flats, similar to a "cabinet scraper" used for wooden furniture. Charcoal could be rubbed over the dried gesso surface on flats and, when scraped away, the white surface would reveal flat and smooth gesso. "Dutch rushes," containing abrasive silicates, were employed historically, although not as commonly on gesso as on applied varnishes and painted surfaces. The reeds were grown in silicate-rich regions (the Lowlands were well known for the supply of the rushes). The abrasive silicate material was drawn up into the rushes' stems, which were then harvested, dried, and used by rolling over the prepared surfaces to release the abrasive powder during rubbing. John Stalker and George Parker mention it in their *Treatise of Japanning and Varnishing* of 1688, as a method of smoothing the applied surface coatings for "japanned" finishes.

Silk and Abrasive Papers

The main method of smoothing gesso, historically as well as in current practice, is "ragging" or "silking." Porcelain-smooth gesso surfaces on moldings, raised forms, and flats alike can be achieved by wetting the dried gesso surface with damp silk or fine cotton lawn, often stretched over a clean finger, before quickly rubbing away and smoothing the resulting gesso slurry to produce a perfect surface.

On flat areas, dry gesso can nowadays be smoothed with abrasive papers. A preferred type is pale gray silicon carbide paper, which generally has a thin backing paper, so it can be better manipulated without "faceting" the gesso surface with false planes. Numerous grades are available: 120 to 400 grit (coarse to fine) will usually suffice, but they should be used selectively: not all may be needed. The silicon carbide paper releases the waste gesso powder easily and does not deposit or transfer anything deleterious onto the gesso. Do not use waterproof wet-and-dry abrasives backed with cloth or specialist papers: the backing is too stiff and there is also a danger of the abrasive grit falling away and embedding into the gesso. Sandpaper is similarly unsuitable.

Gesso-Working Tools

Various supplier-available or bespoke tools may be used to handle, shape, or work the gesso and gilded surfaces. One common, useful tool is a small stainless steel filling spatula, sold in London by an originally Italian supplier for the sculpture trade, Tiranti's. Their small filling spatulas (a size 46 or similar) have a tempered, sprung end and a useful curved-spiked end, both ideal for tooling or working into gesso. A selection of gesso hooks and carving tools are used in gesso cutting, also called "recutting" or cutting "in the white." The technique reached its zenith in both England and France in the eighteenth century. A depth of up to forty gesso layers could be carved, creating intricate reliefs and patterns without the limitations of woodgrain.

Prior to gesso cutting, the dried gesso surface could be wet with a damp silk or cotton rag. (A damp brush could also be used, but when too wet the glue in the gesso will rise to the surface, making the gesso unstable.) Controlled wetting of the surface softened the gesso enough to cut form or texture more easily, and in a more fluid motion. It was common also for English gesso cutters to cut in the white using wood-carving tools. Gesso hooks (fig. 2g) were invariably more commonly used in France.

Wood-carving tools are designed generally to be worked away from the carver, for instance with a gouge shape having an internal curve that produces the hollow cut. The equivalent gesso hook would be pulled toward the gesso cutter, with the working edge of the gesso hook "bull-nosed," as with a stone-carving-shape edged tool, to make cuts shaped similarly to those of the wood-carving tool.

GOLD LEAF

Gold Beating

Modern gold is beaten far thinner than ancient Egyptian or medieval leaf, but the method of beating remains basically the same. The thickness of gold leaf has changed little in more than 250 years, as documented in William Lewis's *Commercium Philosophico-Technicum* of 1763–65. The first recorded gold mine was opened in 1500 BCE by Pharaoh Thutmose III. Although there is some automation in the modern process, hand beating is still preferred for the final beating stage of the gold.

The demise of the goldbeating industry in England, beginning in the early 2000s, is almost complete today, with most gold now imported. The high cost of gold leaf (perhaps more than the value of the gold itself) reflects the labor-intensive beating processes. Most gold leaf is currently imported to Britain from China. Sadly, it is believed that the craft has now died out in Britain; world economics may have dictated that it is no longer viable to produce hand-beaten gold in the UK.

Traditionally, the goldbeater's craft required a long apprenticeship. Family-run goldbeating companies in Britain were handed down over many generations. These included W. Habberley Meadows Goldbeaters in Chelmsley Wood, near Birmingham, and George M. Whiley, originally in Ruislip, Middlesex. In London, the Clerkenwell area was the center of the goldbeating trade. Many small, family-run companies both beat the leaf and supplied gilders with the sundry materials required for gilding. The Clerkenwell area of London was badly bombed during the Second World War, and the craft died there and then. One later company, Stuart R. Stevenson, is now the only supplier of imported gold and gilding tools/materials in that area: a nice continuum of history.

For the beating process in England, the raw material, gold grain, was heated to a temperature higher than the metal's melting point, to improve its working qualities, and was then cooled quickly. It was cast into ingots of approximately 9 × 1 × ¼ in., a size suitable for the rolling process (all still imperial measurements). Oiled steel rollers hardened the gold as it was pressed into ribbons. The gold ribbon was passed through the rollers around thirty times, until strips exactly 1½ in. wide and 10 ft. long to the ounce were produced. The annealing and beating processes followed: the gold was cut into squares placed between leaves of calfskin vellum, ox gut, or, later, treated Melinex polyester film sheets about 4 in. square. Two parchment "sleeves" at right angles held the gold interleaved sheets together in one packet; next, this "cutch" was beaten for about twenty minutes with a sixteen-pound hammer, until the gold squares had expanded to the size of the separating sheets. The gold pieces were then removed and quartered with a steel knife and placed between skins of ox gut 5 in. square: a "shoder" making 600–750 leaves.

The shoder leaf was subsequently beaten with a twelve-pound hammer for two hours, until the gold had reached the size of the skins. Once again, the gold was removed, quartered with a knife, and placed between skins, ready for the final beating. The skins were traditionally rubbed with calcined gypsum "briming powder," which was originally applied on a hare's foot, as had been the method since antiquity. After two to five hours of hand beating with a ten-pound hammer, the gold was cut into 3¼ in. squares with a bamboo

cane "wagon" and placed between the rouged pages of the books with boxwood or bamboo tweezers. The gold was then 150,000th of an inch thick; one ounce of gold generally produced eighty standard-size books of leaf, each containing twenty-five leaves.

Purity of Gold

Pure gold is assigned as containing twenty-four karats. Thus, the purity of gold is expressed in the number of karats out of twenty-four. Other metals may be alloyed with the pure gold to change its color and to harden it. Pure gold is very soft, and by its nature it has to be beaten thicker than the lower karat gold leaf currently in common use. Gold leaf described as "sixteen karat" (16K) contains sixteen parts pure gold and eight parts other metals, combined to make up to the twenty-four total. A gold type commonly used now is 23¼K. There is no measured industry standard for the thickness of gold—it varies from one beater to another.

Colored Gold

If copper is beaten with pure gold, the leaf has a reddish hue. White gold looks like silver, but it is actually gold beaten with a proportion of silver; this results in a more malleable leaf with the advantage that the inert gold slows the quick tarnishing time of pure silver. Many colors of gold leaf are available, including green, lemon, red, citron, and black.

Even if similar karat values are given, leaf produced by different goldbeaters may be different colors. The percentages of additional metals can vary, resulting in color change (thus each individual gilding project requires the same suppliers' gold throughout). In gold with only two-karat difference, color variation is minor but visible. Silver-colored metals include silver, white gold, aluminum (unsuitable for water gilding), platinum, palladium, and black gold.

Colored gold is commonly available in a standard leaf thickness (specific to each beater), but gold can be beaten in both "single" and "double" weight. Since the cost is mainly in the beating, double gold is not twice the price of single gold, although it is usually nearly twice as thick. Double gold gives a more solid appearance, as its thickness allows less light to transmit through it. All colored gold will eventually tarnish (oxidize); pure gold does not, hence its value since antiquity.

Loose Leaf and Transfer Leaf

Gold leaf is available as both "loose leaf" and "transfer leaf." Both types are sold in twenty-five-leaf books as standard.

Loose Leaf

Only loose leaf is suitable for water gilding. Gold is sold in "books" (fig. 3). Each gold leaf is placed between sheets of rouged tissue paper; the gold is loose and moves easily out of the books that hold it. The standard leaf size is usually 3¼ in. square, while a standard book contains twenty-five leaves. Gold has been beaten to this size for hundreds of years. (It is interesting to see how little leaf sizes have changed, even since the Renaissance.)

Transfer Leaf

FIGURE 3 Book of gold leaf on gilder's cushion with gilder's knife and tip.

Transfer leaf can only be used for oil gilding. After beating, gold leaves are pressed onto loose, generally white tissues that are rectangular and larger than the standard book size. The gold is released from the tissue by applying pressure to the back of the tissue, hence its use in outdoor gilding (e.g., sign writing or in-situ sculpture). The reconstruction of Shakespeare's open-air Globe Theatre in London in the late twentieth century employed 24K pure transfer gold during the in-situ gilding of the stage. Transfer gold cannot be burnished, and it can be less lustrous than loose leaf as the pressure in applying the gold to the tissue can transfer the texture of the tissue onto the finished gold surface. When oil gilding inside, even if the piece will eventually be located outside, loose-leaf gold is preferable to use, as it is more lustrous, and its application is not limited by the transfer-leaf tissue.

Shell and Powdered Gold

Shell gold can produce true "gold paint" if combined with a binding medium. Anything else labeled "gold paint" is generally not gold, but rather is commonly bronze powder bound in a paint medium. Shell gold is made by grinding gold leaf in a mortar and pestle, with honey as a lubricant. Once ground to the desired powder size, the honey is cleared away with successive washes of hot water. The resulting gold particles are then combined with gum arabic and dried in pans, ready to be reactivated with water (similar to watercolor paints). Early painters and gilders named this type of ground "shell" gold because the little gold tablet of paint was originally stored and used in mussel shells. Shell gold is now marketed in plastic pans (fig. 4).

Shell gold is commonly used for fine-line areas of gilding, to enhance borders, or to add gold accents to paintings. It is an expensive material and is never used on large areas, where gold leaf would be cheaper and create a better, more lustrous effect. It is granular in nature, compared with gold leaf.

FIGURE 4 Shell gold.

Powdered gold is sold in dry form, as a finished product. It is sold by the gram in small containers. It is too costly to be used for large areas of gilding. In use, it is less granular than shell gold, but is still particulate in nature, producing a "softer" appearance than beaten gold leaf, as reflected light is refracted by the angular nature of the gold particles. It is commonly used for small working areas, as in the reconstruction of border designs in ceramic conservation, applied over oil-based gold size (see "Mordant or Oil Gilding").

WATER GILDING

The quality of gilding is only as good as its underlying preparation. Water gilding generally requires a grease-free, clean, wooden support on which preparatory layers are applied. The layers are always applied in the same sequence, and each is necessary for the stability, aesthetic, and longevity of the gilded surface.

The wood grain is lifted and opened by applying a sizing coat of hot animal glue (rabbit skin or parchment) at a specific strength, to reduce the glue in subsequent layers of gesso from being absorbed by the wood (a default proportion by volume of 1:10 parts glue to water; see "Glues"). Once dry, successive layers of gesso using the same rabbit-skin glue are applied until the desired depth is reached (which varies based on the nature of the project).

Ground Layers: Gesso

The Italian word "gesso" (Italian for gypsum, i.e., plaster) is used in England to identify the inert white gilding ground beneath water gilding. There is no equivalent English term for the material, so "gesso" is used in the vernacular. It should be noted that gesso as a gilding ground is *not* plaster (one type of which is roasted gypsum, as in plaster of Paris). Technically, gypsum is calcium sulphate, while the chalk used for gesso in Northern Europe is calcium carbonate.

Gesso is a mixture of animal glue and gilder's whiting (an inert white filler, usually chalk in Northern Europe), applied in numerous layers while just warm, until the desired thickness is achieved. The required gesso depth varies: standard may be 1 mm to perhaps 5 mm, but it could encompass as many as forty layers (up to 10 mm) if the gesso is then to be carved into designs, or cut in the white (fig. 5).

FIGURE 5A Mock-up board of French technique illustrating (left to right): bare wood, "clair colle" (i.e., sizing), gesso layers up to final polished layer, red bole over yellow.

FIGURE 5B Mock-up board of English technique illustrating (left to right): bare wood, eight layers of gesso up to final polished layer, yellow, red bole, gold leaf.

Purpose of Gesso

- Provides a smooth, stable layer to take the gold leaf. Fashions have sometimes dictated that instead of imitating smooth, solid gold, the gilded surface is "distressed" to reveal the underlying layers (eventually perhaps the gesso).
- Stabilizes a wood substrate (as on a panel painting, for example), and buries the texture of the wood grain. It also provides a cushion, which allows a burnish to be effective. Burnishing (applying timed, controlled pressure onto an area of recent gilding) is now done using shaped agate stones set in handles. The technique compresses the gold into the underlying bole and gesso layers, polishing the bole and gold together to form a deep, reflective sheen.
- Provides scope for texturing the surface, enabling light to be reflected off the gold at different angles of incidence, which results in visual balance between matte and burnished areas. Plain matte areas overall or, conversely, large areas of deeply burnished gold flatten form. Texture is added so that the surface can take matte washes or color, both important in toning gold.
- Used as a filler and leveler. A thick gesso depth was often used to level uneven construction joints, and to cover the strengthening linen strips ("intelaggio"—see "Gesso Grosso").
- Can be used as the medium for actual design elements, for instance, "pastiglia" (raised gesso) and "intaglio" (incised gesso).

Whiting

To make gesso, animal glue at the correct strength is mixed with the appropriate quantity of inert white filler, called whiting. Southern European gesso is usually made with calcium sulphate (gypsum), while Northern European gesso uses calcium carbonate (chalk). Quarried chalk is refined and cleaned until fine enough to be classified as gilder's whiting. It is completely inert. Italian Renaissance gesso (for instance, on panel paintings) was originally applied in two forms: gesso grosso (coarse gesso) and gesso sottile (fine gesso). It is uncommon to find these types in English gilding, in which one gesso type was generally used throughout, made from chalk whiting.

Gesso Grosso

In period English understanding, this was the initial gesso preparation, covering the coarse linen (intelaggio) applied with animal glue over rough joinery associated with Italian furniture at that time (e.g., a cassone). The gesso grosso layer consisted of plaster of Paris (calcium sulphate) mixed with parchment size, and then applied thickly, usually in one application. When mixed with parchment size, plaster of Paris dries slowly and becomes very hard, producing a more durable gesso. However, gesso grosso produces a coarse surface, which must be overlaid with a smoother gesso, gesso sottile, for a suitable gilding surface.

Gesso Sottile

The gesso sottile layer provides the fine, smooth surface required for gilding. It is made from "slaked" plaster of Paris added to parchment size (using the same glue as grosso). Fine plaster of Paris is slaked by mixing a small quantity of plaster with a large amount of water (approximately five pounds fine dental plaster to several gallons of water).

Continual stirring for the first day and regular stirring for the next month ensure the "rotting" of the plaster: the particles cannot join together to form a crystalline matrix as they would in normal plaster-setting processes and they eventually regain the water lost during the initial gypsum-roasting process in producing plaster of Paris, so the plaster becomes inert. The water is then drained off and the wet plaster is squeezed through muslin and dried, ready to be ground and mixed with animal glue to make the gesso. It is a lengthy process, but it results in a beautifully smooth, soft filling material for the final gesso layers.

The Gilders' Whiting Family

CARBONATES

Carbonates are rock-forming minerals in a sedimentary group, i.e., rock formed by deposition. They largely make up the group of limestones. Major carbonate minerals:

- CALCITE: hexagonal crystals: occurs mainly in limestone and chalk, but is also in marbles formed from limestone when tremendous heat has caused the rock to change.
- ARAGONITE: sharp, pointed crystals often found in beds with gypsum, forming coral reefs. Aragonite can change to calcite under pressure. Thus carboniferous limestones were originally coral.
- DOLOMITE: calcium carbonate + magnesium carbonate. A name given to both the mineral and the rock.

CALCIUM CARBONATE

CHALK
Made of a mass of animal tissues. Skeletal deposits laid down.

LIMESTONE
Often made of chalk, having undergone geological processes.

CEMENT
Clay + chalk or limestone.

MARBLE
A metamorphic rock having undergone a change of state, this form of marble is produced when limestone is subject to heat. This forms a very fine composition: MARBLE DUST.

SLAKED LIME
Calcium hydroxide ($Ca(OH)_2$) (quick lime). Formed by reaction with water on baked limestone. Process takes effect at 525° F. (heated in kilns) but temperatures can reach 1000° F. Pure lime is gained by heating marble (more refined). Lime is then slaked by mixing quicklime with water.

MORTAR
Slaked lime + sand + water.

PLASTER
Slaked lime + water (ash added for fine result). A hard crust forms where the surface layers react with carbon dioxide in the air, forming calcium carbonate, a limestone. Used as a fresco base.

GILDERS' WHITING
Main constituent is chalk.
A commercial product refined to a high standard.

SULPHATES

These have fibrous crystals occurring in bedded deposits as a result of seawater evaporation.

Chief uses are in the building industry in the form of plaster of Paris, plasterboard, fillers, etc.

Major crystal varieties:

- ALABASTER
- SATIN SPAR
- SELENITE

CALCIUM SULPHATE

GYPSUM
Hydrated calcium sulphate. Fibrous crystals.

PLASTER OF PARIS
Formed by heating gypsum to 100–200°C to drive off molecules of its water "construction" in its crystalline form.
Plaster of Paris sets due to the formation of interlacing masses of fine needles of gypsum. Slaked plaster of Paris involves diluting it to a high degree. The crystals are so dispersed that they are not able to link. Plaster of Paris is used in cement, wall plaster, artificial marble, moulds, casts, bandages, etc.

WHITING
By slaking plaster of Paris until the crystals can no longer interlace, rotting takes place, and the finest gilders' whiting can be made.

FIGURE 6 The Gilders' Whiting Family.

Gesso sottile was the ground for panel paintings and delicate gilded carvings and had the advantage of shrinking down into the surface, thus retaining a level of carved detail. This gesso burnishes differently than the chalk-based whiting of Northern Europe. The amorphous structure of slaked plaster of Paris is different from the nature of chalk whiting, and as it is softer it is generally acknowledged that gesso sottile burnishes more sensitively.

Northern European gesso uses calcium carbonate (chalk) for the white filler, bound with the animal glue and applied as one material, making the two-gesso system of gesso grosso and gesso sottile unnecessary.

Today rabbit-skin glue is more commonly used than parchment size. Rabbit-skin glue is readily available in powder or granular form and is easier to prepare.

Gesso Bulking and Filling Agents

Chalk (calcium carbonate) and gypsum (calcium sulphate) are two types of inert white filling materials bound with protein glue (e.g., rabbit skin or parchment) to make gesso (fig. 6). Historically, they were generally used according to the location (and therefore source of materials) of the original gilders. While it is still common to find that Northern European work uses chalk whiting and Southern European work employs the two-part system of gesso grosso and sottile, using gypsum, this is not always the case. Specific gesso types have different handling qualities and produce different effects, so they are chosen accordingly. Period treatises provide insight into the working practices of original craftsmen in their choice of materials both based on supply location and allowing for absolute control of materials in use.

However, in general, the Northern and Southern European gesso preferences remain the same, particularly with Italian work, in which the two-stage system of gesso grosso and sottile (both gypsum) is still common. In Britain and Northern Europe almost all water gilding employs the single-material preparation of the layered chalk-gesso ground.

Other forms of the inert constituent of gesso include kaolin (china clay), which is neither a carbonate nor a sulphate, but a clay. "Clay" is technically a geological term denoting the particulate size of a material (i.e., "clay grade"), but in the vernacular it is used as the actual name for the clay material. Kaolin is commonly found on Eastern work (such as Chinese and Japanese), particularly polychromed sculpture. It paints, gilds, and burnishes well, but it imparts a creamy color to the ground, so may not be suitable as a chosen painting/gilding ground if a pure white is required.

Glues

Glue (or "glue size," or "size") is required to bind the inert whiting particles together, to produce gesso. Animal (protein) glues are used. These consist of long helicoidal strands of molecules (collagen is the main protein) held apart by the quantity of water with which they are mixed. Thus, the proportion of water to dry glue is vital in achieving good binding between the glue and the whiting.

Behavior of Glue in Gesso

When a protein glue is mixed with water and heated, the long helicoidal, spring-shaped strands expand and stretch, becoming longer and flatter, which allows inert white filler (usually whiting—chalk [calcium carbonate] in Northern Europe) to be incorporated into the liquid. On cooling, the expanded protein chains contract, trapping the white filler (chalk) in the gelled mix. When applied during its liquid phase, gesso is

mobile enough to be stippled or brushed on, but on gelling through cooling and eventual drying through evaporation of its water content, the gesso contracts and dries to form a hard, controllable surface on which to paint or gild. A gesso craftsman will have complete and precise control over every element in the production, application, and use of gesso through an intimate understanding of the nature and handling of the materials. Glue concentration is important as this will impact the gesso's behavior—it should be neither too weak nor too strong.

WEAK GLUE

Weak glue results when too much water produces large distances between the glue particles; the glue's protein ribbons are too far apart to join and form a good bond. In practice this produces a powdery, unstable surface. The surface can also be unstable if too much whiting is added, similarly separating the glue particles too much to join and bond properly.

STRONG GLUE

Strong glue is the result of not having enough water for a given amount of dry glue, so that the glue's collagen protein strands are linked together too tightly: the glue is too strongly bonded within itself, lessening its capacity to bond well to the adjacent materials. In practice, this produces a shiny surface when rubbing down. It is then often difficult to achieve a smooth surface without producing hard plateaux of polished glue. There is also a danger of the gilding layers exfoliating when burnishing the gold, as the burnishing action compresses the glue layers, making them even stronger within their own depth and liable to flake away at a weak interface, usually between the lowest layer of gesso and the wood, so all that gilding for nothing! Current Northern European gilding practice commonly uses rabbit-skin glue. The glue strength can be nominally 1:10 parts glue to water by volume, but this may vary from one project to another, or from one gilder's preference to another's.

FIGURE 7 Rabbit skin glue: powder and sheet.

Glue Types

Proteinaceous glues used in gilding include:

RABBIT-SKIN GLUE

Made from hide, bone, and cartilaginous matter from animals. Originally derived from rabbit skins. Used in gesso making; it is not a jointing glue. French rabbit-skin glue is paler and is reputed to be of superior quality. It is water activated and does not resist dampness or heat. Available in powder, granules, or, more rarely, sheet form (fig. 7). It is prepared in a double boiler (bain-marie) or equivalent, or a controlled digital microwave (to monitor accurately by seconds). It is very important not to boil the glue. Best results are obtained if the granules are soaked in water overnight before melting down, as this fully swells the glue granules. Then leave overnight after melting down with heat, to test full gelled strength. Approximate proportions of 1:10 parts glue to water by volume.

PARCHMENT SIZE

It is made from calfskin and produces finer, clearer glue—the finest glue in gesso making. Parchment size was traditionally made by soaking parchment cuttings (about 1 in. [~25 mm] long) in water overnight. The water was then drained off and discarded. The cuttings were transferred to the inner container of a double boiler: 1 part soaked cuttings to 3 parts water. The outer container of the boiler was filled with water and simmered three to four hours until the cuttings had almost disappeared, and only the skin filaments remained (the collagen had been released). The size was then strained through mesh or linen (now nylon tights) and left to cool overnight. Used as a finer substitute for rabbit-skin glue.

GELATIN

A very pure form of animal glue. Can be used for gesso making and bole preparation but is mainly used in gilding conservation (such as consolidation). Produces a virtually clear glue. Available in powder, sheet, or capsules (used in verre eglomise [glass gilding]). Soak approximately two hours in cold water to swell, then heat in double boiler (above 30ºC but not more than 60ºC). A microwave can also be used but it requires very careful control of the heating process as it can result in the glue boiling faster than anticipated. Do not boil. Leave overnight to gel, then test for strength.

ISINGLASS

Fish glue, extracted from the swim bladder of sturgeon. Very fine glue used as an alternative to gelatin capsules in verre eglomise. Not used to make gesso—too weak. Does not form a gel so it can be used cold (hence used in conservation) for consolidation. Sold as a preserved liquid, as dried fillets of swim bladder, or in strand form. Russian isinglass is the best quality but is very expensive and increasingly unavailable.

CASEIN

Originally made from washed and dried curds of sour milk. Used as both paint medium and gesso binder. Tendency to crack. Limited shelf life (three to four months). Dries hard, producing a strong, brittle layer.

EGG WHITE (GLAIR)

Contains approximately 87 percent water. Proteins are released for use by beating egg white and leaving to stand. The resulting liquid underneath the beaten froth is almost clear and was used as a glazing film and, in Italy, as a binder for bole. Brittle. It was not commonly used in England.

EGG YOLK

Not used in gilding per se, but used as the medium for gesso-prepared and gilded panel paintings. Mixed with an equal quantity of water to create an emulsion, it forms the medium for egg tempera paint. It contains a high proportion of fats (lipids).

Testing the Strength of Prepared Glue Size

After soaking overnight and gelling, the cold size should feel like a stiff table jelly. If the glue is from the same batch as used previously, its strength can be assessed initially by color; glue from different suppliers may appear lighter or darker but be the same strength. As a rule of thumb, however, the darker the glue, the stronger it is, and the paler, the weaker.

Next, try impacting the set glue in its vessel against the palm of your hand. The glue "resonance" should be quite firm—it should not be loose. If a finger can be pushed into the glue without it breaking apart unless strong pressure is applied, it is too strong, in which case, melt it down and add more water. If you cannot make a clean cut in the glue with your finger, and it immediately gels back together, it is too weak; in this case, melt

it down and add more glue granules. An average glue of the correct strength yields to a finger pushed into it to produce clean "cut" edges. Never keep glue for longer than about one week unrefrigerated, or even more than a few days in warm environments. It is an organic material and will rot. It can be kept longer in the fridge. If it smells stronger than when freshly made, it should not be used. Throw away suspect glue and make more.

As long as the glue never boils, microwaved glue will keep for longer; microwaving irradiates the glue, slowing down deterioration and eventual decomposition. Remember that the glue must not boil—boiling glue weakens the ability of the heat/moisture-expanded helicoidal molecules to contract back into their default "spring" shape when cool, thus impeding successful gelling of the glue. Boiling also introduces air into the system, producing pin-prick bubbles that can be seen through the gilding.

Support Types and Their Preparation

Gesso Supports

Gesso can be applied on different supports, such as wood, plaster, or stone.

WOOD

The wood must be bare, clean, free of previous finishes or grease, and well seasoned.

Choosing the right type of wood is crucial. The ideal wood for flat panels has a straight grain with few knots, while woods such as pinewood or limewood are common for carvings or three-dimensional work. Oak was frequently used in Northern Europe, but it was well seasoned, as the acidic tannin within could otherwise "throw off" the gesso preparation layers.

Italian panel painters commonly used poplar wood as a support, while oak was favored in Northern Europe. Mahogany and walnut were used when "parcel gilding" (part gold, part wood) on mirrors and furniture became fashionable: the richness of the wood color and grain were set off against selected areas of gilding (either water or oil)

Gilded carvings, sculpture, and picture and mirror frames were usually made of limewood or pine. Oak was also used, though less commonly than pinewood or limewood as the beauty of oak's grain was buried underneath gilding. For modern panel gilding (such as flat samples), composite boards of plywood or medium density fiberboard (MDF) are acceptable. The urea-formaldehyde in the MDF binder is a health hazard as dust but has no measured effect on gilding. Oily woods such as teak are unsuccessful supports for gilding: the natural oils resist the water-based gesso layers. Fire retardants added into some kiln-dried woods (e.g., oak) can throw off the gesso too.

PLASTER

The porosity of dry, set plaster of Paris allows it to take gesso, and thus enables successful water gilding. Numerous layers of rabbit-skin size need to be applied onto the plaster before proceeding as with wood, however, as the plaster surface is too porous to leave the gesso stable.

STONE

Porous, unpolished stones such as limestones (e.g., Portland) take gesso well, and can therefore be water gilded, although oil gilding on stone was historically more common, with no requirement for gesso unless to fill texture on internal stone work.

Preparation and Application of Size

If using rabbit-skin glue, soak a 1:10 proportion by volume of glue to water overnight, then heat in a double boiler or microwave until it has melted into a homogenous liquid and, if required, allow to cool before testing for strength and finally melting again to make gesso. If using parchment clippings, simmer 4 oz. to 2 pt. water for at least two hours and then strain the size. Allow overnight gelling, then test for strength; it should feel like a stiff table jelly, as with rabbit-skin size. Before applying gesso on material such as silk or linen, apply hot glue size (rabbit skin or parchment) over the wood substrate. This opens the wood grain and forms a key for the gesso.

USE OF CLAIR COLLE (THIN WHITE/SIZE WHITE)

At the sizing stage, a large handful of whiting can be added into the hot rabbit-skin size (this is optional and was more commonly used in France than in England). English vernacular evolved the French name of this size formula, "clair colle," into "clearcole." Clair colle can be applied instead of rabbit-skin size alone, to similar effect, but it contains enough whiting mixed with the size to give it a milky appearance. It provides a "tooth" on which subsequent gesso layers can adhere mechanically. There is no practically discernible difference between using clair colle or rabbit-skin size alone at the sizing stage. It is used in the same way as parchment size. Both sides of a panel must be sized to prevent warping upon drying (due to contraction). Apply the size generously with a stiff brush (hogs' hair), but avoid puddling. Again, remember that the glue must not be boiled once prepared.

Before sizing softwoods, knots were historically sealed with a varnish (such as shellac) to prevent the wood resin (e.g., pine tree sap) from bleeding. In earlier times, muslin, linen, or tin foil was applied over knots and metal fixtures.

USE OF SILK/TEXTILE BENEATH GESSO

On flat panels, it may be necessary to apply silk, linen, or a similar textile to cover grain, knots, shakes, or joints to help prevent possible movement of the wood from cracking the gesso layer above. (Japanese lacquer often used mulberry paper or silk as a base.) Always use fine cloth, such as silk, on wood joints in carvings or furniture, and over knots, shakes, dowels, or cracks (though not over the entire area). Linen was often used over joints in beechwood chairs (beech is notorious for warping).

Silk is the ideal material. It is applied with the same hot glue size as used for sizing up the wood, and at the same stage that the hot size is applied. Give the fabric a further size coat after its application, to ensure good adhesion by saturating the fabric with glue (without puddling). Allow to dry thoroughly (a few hours to overnight) before continuing with the gesso application.

Italian Renaissance furniture often used linen as the intelaggio layer between the sized wooden carcass of a cassone (chest) and the overlying gesso layers. This improved the structural integrity of the piece and would be covered to flush by the overlaid gesso grosso and gesso sottile.

Gesso Preparation, Application, and Finishing Processes

Use the same rabbit-skin size strength (or the same actual glue) as previously prepared for the initial size layer (perhaps a 1:10 ratio), the gelled strength of strong table jelly. Warm the glue until it is liquified (around 60ºC), then add enough whiting to produce the consistency of thick cream as a default mix (fig. 8). There is no correct measurement of this, as gesso mixtures vary according to the wood being used and the depth of the required decoration.

Gesso for pinewood or beechwood may vary in whiting quantities as the wood's hardness and the nature of its grain are factors in determining how soft and deep the gesso should be. The glue strength should always be constant and standard; it is the quantity of whiting that can change. "English gesso" is a term that is used for a thinly made gesso applied to shallow carved forms (e.g., Georgian walnut parcel-gilt mirror frames with the mirror's shallow-carved sight edge water gilded without re-cutting in the white). A default glue-to-water proportion size of 1:10 requires less added whiting than what would be used if greater depth of gesso were needed for future re-cutting or texturing processes.

FIGURE 8 Gesso preparation: calcium carbonate dropped into warm glue with fingers.

It is common, with experience, to make gesso in a similar way to mixing plaster of Paris, by adding the whiting into the center of the hot size, until the dry whiting peaks just above the surface of the size. At that point, the mixture is stirred gently and continually, with a flat stick to avoid introducing air bubbles. An alternative is to add in the whiting a handful at a time, stirring in between, until the desired consistency is achieved for the task at hand. This will initially produce more air bubbles, but careful stirring and straining should alleviate this type of bubble. This method is slower but allows more control for the inexperienced.

A single-dip brush test should be undertaken on a bare piece of wood when the gesso consistency feels thick enough. This comes with experience. The gesso should produce a smooth, even covering and not look watery. When satisfied with the consistency, strain the gesso through a double layer of tights stretched across a pipkin or bowl. Stir the strained gesso and warm gently if required.

APPLICATION OF GESSO

Ideally, gesso should be used at normal blood temperature (37°C) or below. Bubbles may result if the gesso is too hot, or if layers are put down when the previous layer is too dry. A temperature differential is unhelpful. If the previous gesso layer is "white dry," it is too dry, and it will invariably cause subsequent layers to bubble. The white-dry gesso has contracted, so air naturally trapped within the lower gesso layer may expand in contact with the higher temperature of the liquid gesso being applied over it, and pin-prick bubbles may pop through during the drying of the fresh layer. If the gesso is put down using a flat brush, apply the first one or two coats with a hogs' hair bristle brush, working the gesso well into the surface. Apply layers in opposing directions. Gesso does not behave like a paint or varnish and should not be handled as such. Lay it on generously in a swift, flowing motion, without excessive brushing out. French gilders commonly apply gesso using round, string-bound hogs' hair brushes, stippling the gesso (fig. 9). The "English" way is to brush the gesso on in successive flat coats.

After the initial coats, apply the gesso with a softer brush if desired (ox hair or similar). On flat panels, apply a minimum of an average of eight coats; there is no maximum. On carved surfaces, apply a nominal four coats over the entire area, and then build up another four (or more if required) on raised areas that may be burnished. There are no set rules for the number of layers. You will need enough to allow for burying wood

FIGURE 9A French technique of gesso application in which gesso is tapped on.

FIGURE 9B English technique of gesso application in which gesso is brushed on.

grain; smoothing the gesso surface after drying overnight; cutting designs if required; and, finally, for the burnish to be successful.

For "cut gesso" designs, at least twelve to twenty coats should be applied, or more if required by the project. Color the fourth gesso coat from the bottom up as this serves as a depth guide when cutting a design, to avoid cutting through to the wood. Use stable earth pigment in the gesso (e.g., red ocher) or a thin watercolor wash for this one layer. Apply each layer when the previous one is "matte dry," not white dry, as the latter will result in bubbles.

Do not leave the gesso in hot water to keep it liquid during application; this will detrimentally accelerate evaporation, affecting the glue strength and the fine balance of size to whiting as you move upward with the layers. Some gilders add water to compensate, but there is no measurable way to know how much water has been lost, so without experience, the nature of the gesso may be changed adversely, possibly causing eventual tension between the gesso layers and resulting in instability and possible future delamination.

TO HELP AVOID BUBBLES

- Never allow gesso to become too hot, or subject it to extremes of temperature. When warming gesso, boil the water and then remove the pan from the heat and set the gesso bowl in it to warm the gesso gently, stirring continuously. Remove the gesso bowl from the hot water as soon as the gesso has liquified. If microwaving, liquify with extreme caution, heating the gesso a few seconds at a time, then stirring, to avoid overheating.
- Historically, after the gesso was made, a pea-sized lump of Russian tallow wax was melted into the warm gesso. This broke the gesso's surface tension, allowing free escape of any rising bubbles. Alternatives to this include a drop of refined linseed oil, alcohol, sunflower oil, oxgall, or other wetting agent. Most gilders add nothing, and all is fine.
- Do not stir excessively or too rapidly. If bubbles do occur on the object while gessoing, brush the liquid gesso well into the bubbles as soon as they appear, or rub the liquid gesso in with a clean finger in these areas. Gessoing over bubbles in subsequent coats can result in the bubbles increasing in size as they expand through the warm, newly applied layers.
- Apply all the layers in one day, using the same batch of gesso.

DEFECTS IN THE GESSO

- Pinholes: gesso too hot; temperature range too great; layers applied when previous layer too dry; or defective application of first layer.
- Flakes: too much whiting in proportion to glue; or glue too weak.
- Lumps: bad straining; or wiping brush against bowl, thus picking up half-set gesso on the brush.
- Skinning: gesso too hot; or made in too small a quantity for gesso volume to maintain an even temperature.
- Cracking: layers applied too thickly; or applied too soon over previous layer that was still too wet.

TEXTURES IN GESSO

Texture is added to gesso to provide visual equilibrium in the gilded surface. It also gives the gold a key to take color and toning. Texture can be produced in wet or dry gesso. Wet works more quickly but requires experience and good tool control (fig. 10a–h).

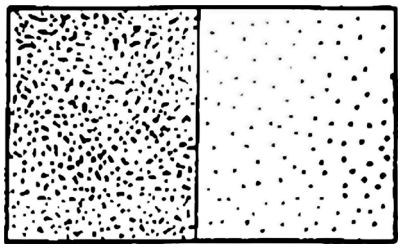

FIGURE 10A Sanding: Used on picture frame flats, i.e., central flat moulding. Different grades of sand applied. Sometimes adhered to dry gesso, oil-sized surface, or sprinkled into wet gesso. Sand often gessoed over to soften grit. Usually oil gilded but can also be water gilded.

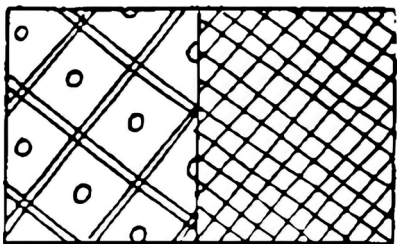

FIGURE 10B Cross-hatching: Used to hold toning on background flats (e.g., picture frames). Provides balance to burnished areas. Narrow x-hatching done on general background areas. Wide x-hatching in corners and centers, often with punched central dots. Use a spiked spatula or sharp tool to "draw" into the white. Do not use straight-edge.

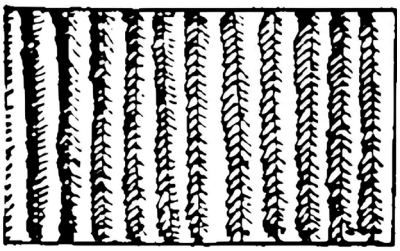

FIGURE 10C Fluting: Found on inner frame edge: "site edge." Has "wave" cross-section (no flats between peaks). Use a gouge or fluter. Burnish or matt.

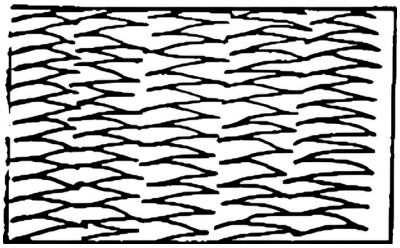

FIGURE 10D Hassling (or "razzling"): Common in Europe, especially polychrome sculpture. Found on any flat or gently rounded surface (frame or furniture). Chisel or gouge "walked" along surface. Used to disperse light and hold pigment.

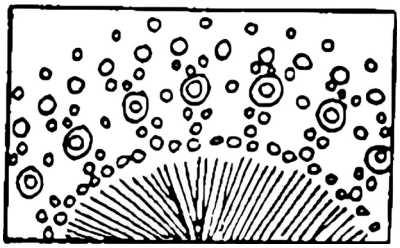

FIGURE 10E Punchwork: Done in completed gilded surface. Common around haloes or nimbi on panel paintings. Use ground, polished nails plus dental tools. Indentations are burnished as gesso is compressed. Lines can also be drawn using a rounded scribe or "pencil" burnisher.

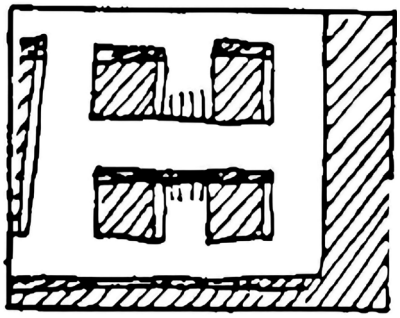

FIGURE 10F Cut Gesso (Intaglio): Gesso built up to depth of ¼" or more, carved into intricate low-relief designs: sharp and detailed. Used on furniture and frames.

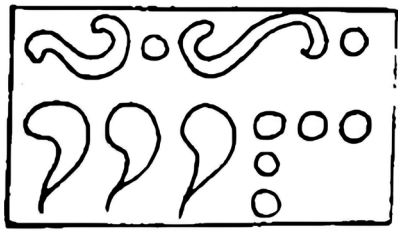

FIGURE 10G Raised Gesso (Pastiglia): Gesso loaded onto brush, then flowed and drawn onto flat gesso surface. Also effective pushed through a syringe or icing bag. Used in conjunction with cut gesso or on its own. Smooth, rounded effect, opposite to cut gesso.

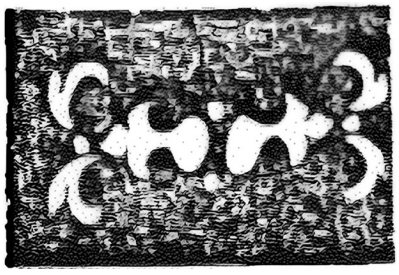

FIGURE 10H Sgraffito: Not a texture but a decorative treatment. Egg tempera painted over previously water gilded and burnished surface. Design drawn through at specific paint-drying time, revealing gold. Found on borders and on polychromed sculpture.

FINISHING AND PREPARING GESSO FOR BOLE

On a flat panel, lightly rub down the dry gesso with fine silicon carbide papers (or garnet sandpaper), working from coarse to fine (in the range of 120 to 400 grades). Historical alternatives include metal cabinet scrapers or glass. Rub down using a circular motion, from the center out. Do not push the paper forcefully from side to side as ridges and plateaux will develop. On a flat panel, using the papers on a sanding block may remove too much gesso and may result in a surface that is too "unnaturally" flat, or may form a different plane to the underlying wood section, potentially revealing grain.

On carved areas use fine silicon carbide paper if necessary or, preferably, "rag" the surface: dampen a piece of soft fabric (e.g., fine silk) and rub gently over the surface, then clear the area with a dry finger. The moisture will soften and finely spread the gesso. Ragging is generally the best way to prepare carved surfaces on which further gesso work is required. Minimize the water content, as over-ragging will dissolve and strip the gesso. The capillary action of water causes the glue to rise from the lower levels, eventually resulting in an unstable, hard film on the surface.

Where texture or form is needed, "gesso hooks" are traditionally used. These tools have bullnosed cutting edges in a wide variety of shapes, and are used by drawing the tool through the gesso, toward oneself. Some gilders prefer to work in wet gesso, others in dry. Woodcarving tools can be preferred now for modern English gesso cutting, as alternatives to hooks. These are used as they are for woodcarving, cutting away from the craftsperson. Please note: gesso will blunt carving tools, so frequent sharpening and/or stropping may be required.

The fashions of the time have dictated how much smoothing and re-cutting was done. Renaissance gesso work is very soft and flowing, with no emphasis on sharp definition. The form underneath is deliberately obscured, creating a contour suitable to take gold without the gold cracking over sharp edges or faulting into a V-shaped cut. Louis XIV work is the opposite: its forms are well defined and sharp, all re-cut in the white.

Too many sharp angles and cuts result in an unsuitable surface to gild, as the gold does not take a V shape easily, and tends to break or "bridge" over these forms. Gold will freely pull down into a U-section, however. Woodcarving destined to be gilded is always cut more deeply than other woodcarving to allow for this softening of form once the gesso is applied. The 1970s and 1980s English fashion of stripping pine destroyed much beautiful gesso-cut design that was originally cut in the white. Once the intricate gesso cutting was lost, skeletal wooden carvings were revealed, which were originally cut deeper deliberately to allow for subsequent gesso depth and detail, giving the final pieces their original integrity.

Bole

Nature and Purpose of Bole

Bole is a combination of protein glue (e.g., rabbit skin) and colored clay (fig. 11), which is applied over the prepared gesso surface. It composes the layer onto which the gold is applied, and is effective for burnishing. It is formed from fine (pipe) clay, which consists of tiny, flat platelets that are able to glide across each other when put under pressure, that is, when burnished.

The term "clay" technically refers to a measure of particle size in geological materials ("clay grade"). It is used generically now, as the name for the clay material itself. Pipe clay was used by British coal miners to

make their smoking pipes. It is the geological strata immediately below coal seams; whereas the coal was once trees, the pipe clay was the soil in which the trees originally grew.

Bole has several purposes:

- Bole makes the gesso less porous: it slows absorption of the size water used in applying the gold leaf.
- Bole enriches gold color. After beating, regular gold leaf is so thin that some light can pass through it. The light can be both absorbed and reflected by the color underneath, hence the bole color used affects the finished look of the gold.
- Yellow bole (also called yellow clay) is applied over the whole gessoed area; any inaccessible areas where the gold may bridge or may not cover appear to be yellow, which is compatible visually with the surrounding gold color, giving more integrity to the gilded surface.
- Different colored boles used over time had different burnishing qualities; yellow did not burnish well, so it was used on matte, flat areas. Red burnished well, so it was used on the highlights accessible to the burnisher. Black was used for its ability to achieve a high burnish owing to its graphite content (Victorian period), so in the nineteenth century it was used on isolated highlights.

Fashions and the natural wearing away ("distressing") of gilded surfaces have now revealed the bole colors beneath gilding; it is vital to use the correct bole for both the period and the origin of a piece, in order for the gilding to "read" well and for the gilded object to have integrity.

Historically, the best bole came from Armenia, and was a rich, deep red, which resulted in a superior burnish. Its distant source and limited availability made Armenian bole highly prized and very expensive. In previous centuries, if gilding businesses were sold and dispersed, bole quantities and colors were often individually listed in the workshop value, as particular types and colors were jealously guarded and very highly prized. Natural clays all vary in color. For instance, "red" bole can range from hot oranges to deep browns and reds, or bright earth reds.

English Clay

English clay was less successful to burnish without the addition of graphite. It consisted of a mixture of pipe clay (see "Nature and Purpose of Bole" above), ferrous earth colors (pigments), and graphite. English "matte" size was made historically by mixing 8 oz. pipe clay or bole with 1 oz. mutton suet, then adding enough prepared glue size to make a smooth, thin-cream consistency. English burnish clay was made historically by mixing the same quantities of clay and mutton suet, with the addition of 1 oz. black lead (graphite).

Bole was originally available to the gilder in solid, dry "cone" form (fig. 11). The cones were ground, soaked in water, and then added to glue size. The mutton suet content is thought to be specific to historic English bole. The old boles and clays are generally considered far superior to those produced today. Modern boles are now available in paste form, which purportedly needs no grinding, and is ready to take the prepared glue size. Boles now come in a range of colors and types, from various countries of origin, but all are standardized in their particle size, so theoretically all should behave the same way in use (though this is rarely the case).

The economics of the 1970s and 1980s European Economic Community and the Common Market had a big impact on bole types and supply. The French Lefranc family business supplied the gilding trade for generations with good quality boles of various colors. Once French farmers were subsidized, they no longer needed to sustain a clay supply for bole making. The bole manufacturers had to cast further afield for their clays, resulting in standardized bole colors, which no longer reflected local geology or character.

FIGURE 11 Dry clay from Italy, France, and Germany, of various colors.

The Canadian ne plus ultra range of bole colors was reputedly formulated by an intern at London's Victoria and Albert Museum. During his internship, he was taught to make bole from English pipe clay. On returning to Canada, he became a bole manufacturer, supplying the colors used today. (Their names are only an indication of their historic use, e.g., "Georgian orange" may have been a common color in English eighteenth-century gilding, but the same color can also be seen on fifteenth-century Italian panel paintings.)

Historic boles were originally only available to gilders in solid cone form. The liquid paste-clay form was the penultimate stage in the final manufacturing process, prior to sieving through fine mesh. The resulting paste bole cones were then dried before sale as inert materials with an infinite shelf life, allowing for easy transport with minimal packaging. A gilder could test a good, solid bole cone by pressure rubbing the side of the cone with a thumbnail; a good burnish would result if the bole was of good quality. Since the 1970s and 1980s, boles have been supplied in paste form; as a result, there is no indication of their quality until they are applied, gilded, and burnished.

After mixing with rabbit skin glue for application, bole often dries to a color much paler than that of its wet form. Wet paste-clay bole colors match the appearance of aged period boles after original gilding and burnishing, which is an advantage when color matching boles to existing gilding.

Preparation of Bole

If obtained, old cone bole should be ground and then soaked in cold water. When required for use, grind the bole if necessary in a mortar and pestle or muller. From this stage onward, soaked cone bole and paste bole are prepared in the same manner.

Paste bole: Melt a quantity of glue (parchment or rabbit skin) slightly weaker than that used for gessoing. Add the hot glue a little at a time to a small quantity of the bole, and mix gently in a white vessel with a soft brush until all the bole clay is incorporated into the liquid glue. Test for consistency on a spare gesso piece; the color should cover moderately well, but not leave brush marks. It is better to have the bole too thin than too thick, as textural brush marks will be magnified by the gold. Judge the balance of glue to bole clay by color using a white glazed vessel.

Bole clay to glue proportions cannot be judged by consistency, as with gesso, but only by color depth and the bole's nature after test application and drying. When the bole covers the white gesso test area to the desired degree (white gesso should still "grin through" the single bole test layer applied), strain the bole through silk or fine mesh, and warm gently if necessary. The bole should have the consistency of milk. Bole can also be tempered with stale glair (equal quantities of settled, beaten egg-white froth and water), though this bole can be harder to control.

Application of Bole

Generally, apply yellow layers over the entire surface, enough to produce a good color (usually no more than two or three layers). Ensure that all gesso is covered; do not leave any white areas of gesso, as these will absorb the size water used to apply gold leaf, and may result in softer, unstable areas if burnishing in that vicinity.

Apply red over all the highlight areas to be burnished, that is, the raised areas of carving or decoration. Don't worry about painting to an edge; the thickness of the layer will not show if the consistency is correct. It is common to apply one or two layers of red over the yellow, more if the bole is thin. Apply black if required for a chosen project, just on the highlights (such as the tips of flower petals). Keep the bole liquid, but not hot, otherwise bubbles or skin will form. Apply each layer when the previous one is dry (matte). Unlike gesso, the bole cannot be too dry to receive the next layer. The total number of bole layers need not exceed four or five.

Ensure that the bole is liquid and the vessel is warm; gelled bole will leave brush marks.

Apply with a soft brush; historically, a squirrel mop was used, but a soft nylon or sable flat brush is also good. Hold very little bole on the brush and sweep it swiftly over the relevant areas, working quickly, without going over freshly applied areas until the surfaces are dry.

When the bole is completely dry, polish it before gilding with either:

- New bristle house painting brush (½–1 in.), cut off along a straight plane about ¼ in. away from ferrule. Bind the brush ferrule with tape to protect against the metal scratching adjacent areas in use; or
- 1000-grade wet or dry, or two pieces rubbed together to make a smoother abrasive surface (be careful, as abrasive papers may scratch); or
- Grade 0000 oil-free steel wool.

The purpose is only to polish the surface and remove any small nibs. Do not use a burnisher at this stage. Nothing is gained by burnishing the bole using an agate burnisher prior to gilding, as the bole will burnish under the gold after gilding anyway, and over-burnishing the same gilded area can result in the layers exfoliating. Using a burnisher to polish the bole will also dull its surface and ruin it for subsequent gold burnishing.

Applying and Burnishing Gold Leaf

Size Water

The gold is applied to the bole by wetting the surface with "size water." There are several recipes for this, the most common of which is approximatively 1 tsp. glue size to ½ pt. water plus 1 tsp. methylated spirits. It is mixed by color, not by precise measurement. There is some resistance to using mauve methylated spirits, as it is thought that the color can impart into the gilding, but actually the small quantity used has no measurable ill effect, and it may be helpful for less experienced practitioners to judge its quantity by color. However, pure alcohol (industrial methylated spirits, or "meths") is better. The alcohol breaks surface tension and stops the size water from beading. The small amount of added glue replaces the quantity that is potentially lost in wetting the bole. Add more or less glue and/or meths according to the way the bole behaves: if the bole is absorbing the size water too quickly to keep the bole surface wet at the point of laying the leaf, use less meths, and vice versa.

Other English size waters have historically included gin, which is still used. Gin produces a good and even burnish. Lower-quality gin contains more water and can be used neat, while good-quality gin should be mixed with water. Gin-based size water evaporates quickly, so it is best used by experienced gilders, as gold will not adhere to a dry bole surface. Italian gilders often used gilding size water, which included water with a drop of alcohol plus a drop of glair (beaten egg white left to settle). Size water choice is, however, the prerogative of the gilder in any location; there is no regional preference.

Gold Leaf Application

The application of leaf onto a wetted surface is easier to learn by demonstration than from written notes. Gold leaf is controlled by using airflow against it on the gilder's tip, so do not be tentative in laying it: you need the air pressure against the gold leaf to keep it flat, in order to ensure the proper positioning when laying gold leaf (fig. 12).

However, it is important to remember the following:

1. Water gild from the upper surfaces downward so that any size water will not run onto the gold.
2. Do not flood the bole with too much size water or the gold will not pull down evenly.
3. Hold the tip parallel to the surface as it approaches the wetted bole, and do not hesitate; the gold will jump off the tip as soon as it nears the moisture.
4. Do not pull the tip toward you as you lift it away after dropping the gold; doing this may cause the gold to tear.
5. Only tamp the gold down after it has left the tip if it is necessary, meaning if air is trapped under the gold. Tamp down gently with a sable writer's brush held at a 90-degree angle to the gold; this should not tear the leaf if done correctly. It is not ideal to tamp the gold down using the tip, as do some gilders; for the inexperienced, the tip can easily become contaminated with the wet size water, and tamping the gold leaf with it will also reduce the life of the tip's squirrel hairs (a good tip is worth keeping).
6. Lay the leaf so that each leaf overlaps the previous one. This allows for size-water seepage.
7. Size water stains gold, so do not use very small pieces of gold to "fault" (patch) the gilding, or for the initial gilding layer, as this may result in further size-water staining, which is irreversible.
8. When gilding moldings, always gild down into a hollow or "V" cut with two pieces of gold, fitting the leaf edges precisely into the bottom of the carved angle. If gilding a round molding, or a section on an edge, make sure the gold is wide enough to go over the edge and down into the angle or around the form. The bigger the pieces of gold used in faulting, the lower the likelihood of unsightly marks and stains.

FIGURE 12 Laying down gold leaf with gilder's tip.

Burnishing Gold Leaf

After the gold has been applied, the surface is allowed to dry. During this drying time the gold is ready to be burnished when the wetted gesso and bole are not absolutely dry, but rather retain enough moisture to give the layers a "cushion" felt under the gentle pressure of the burnisher. This will give an immediate and successful burnish without bruising the gilding preparation layers; you will bruise if too wet and scratch if too dry.

Burnishing times vary according to the nature, age, and depth of the underlying preparation and the humidity and temperature of the studio. A mild temperature and humid environment (i.e., damp, temperate weather) are best. Test for the correct burnishing time by gently tapping the burnisher onto the gold in an unobtrusive area: the gilded surface should sound hollow and have a resonance. If it is soundless and feels soft to the touch, wait and try again later. It can be several minutes or an hour or so before the gold is ready to be burnished, but a few days is not uncommon, or, conversely, it could be as little as fifteen minutes.

Start the process by rubbing the burnisher gently over the surface, increasing the pressure if the surface does not become shiny quickly. Gradually work over the entire area to be burnished in gentle sweeps all in more or less the same direction, not "round and round," as the burnishing marks will be visible. You are aiming for a smooth, even surface that leaves no clue that it has been achieved by using a curved stone. Do not move on to a new burnishing area until the existing area has been worked over successfully, with no burnishing lines or marks. View at different angles to check.

Burnishing hints:

1. Gauge the "burnishing time" accurately; it is time sensitive. It is impossible to burnish if the layers are too dry and, conversely, the gesso and bole will be destroyed if they are too wet.
2. Do not press too hard; the gesso may be bruised.
3. Do not overburnish the same area; the layers may split apart.
4. Make sure the burnisher is clean and has a good polish, with no facets in the stone. Remove gold "skewings" from the burnisher if they attach to it. A dirty burnisher will scratch the gold. Stubborn gold can be removed from the burnisher with meths or industrial methylated spirits (IMS). (The British equivalent to denatured alcohol, industrial methylated spirits contain approximately 95 percent ethanol with 5 percent methanol.)
5. Only burnish those areas that are high points, or that are naturally accessible to the burnisher. Leave enough areas as matte gold to balance the burnished spots. Too much burnish destroys the form, and the eye cannot read the depth of form, which may be important to the integrity of the object.

MORDANT OR OIL GILDING

Good oil gilding gives a finish that can be as lustrous and rich as matte water gilding. However, no burnish or depth of polish is possible, which could lead to the misconception that oil gilding is easier, faster, or less worthy than water. The oil-gilding method is less labor intensive than water gilding, but the ultimate result will be reflected in the standard of workmanship sustained throughout. There are still no shortcuts to achieving a good finish. Gilding is only as good as the quality of finish in the underlying layers.

Oil gilding is necessary either when the surface is nonporous, and therefore unsuitable to take gesso (thus making water gilding impossible), or if the gilding is to be situated in an exterior location or one where any form of moisture is present. Oil gilding can be applied to a wide range of supports; with appropriate preparation, almost any support can take oil gilding.

However, for interior work, oil gilding on gesso is sometimes preferable, as has been done in the Music Room at the Regency-period Royal Pavilion in Brighton, England, where laminated pinewood carvings were rabbit-skin sized, silked, gessoed, sealed, prepared, and subsequently oil gilded. Sealed gesso is a good, smooth ground for the subsequent layers and gold, resulting in a finish finer than what could be achieved without the gesso, though without the possibility of a burnish. Oil gilding cannot be burnished as the underlying paint and oil-size layers do not have the required characteristics of clay boles.

Oil gilding over wood, without any gesso base, was popular in the nineteenth century, on both frames and architectural elements. The wood was first sealed with shellac; then the oil mordant (originally yellow) was applied and gilded when it reached exactly the right "tack" in its drying cycle to take the gold leaf. Such work was usually done on oak, as its distinctive grain showed well.

On English furniture and frames, the combination of chosen gilded elements balanced with surface-finished wood elements was called "parcel gilding," originating from the saying "part and parcel." Both oil and water gilding were commonly used on the same object (particularly frames) to enhance the inherent qualities of both types of gilding. The nineteenth-century Edwardian Old Library at West Dean College, Chichester, England, has some particularly fine architectural parcel gilding in both oil and water gilding.

Where a gesso ground is found under oil gilding, the gesso is used as a grain filler to give a smooth finish. No thickness or depth of gesso is required, as there is no "cushion" needed for burnishing, therefore the number of gesso layers (if any) for oil gilding is fewer than the number needed for water gilding.

Gold Size (Oil Size)

Oil gilding requires an oil-based layer (a mordant) to attach gold to the surface. "Mordant" refers to an agent that enables one material (e.g., gold leaf) to attach to another (e.g., wood or sealed gesso). Traditional gilding mordants were usually oil based (though garlic juice is known to have been used in ancient

gilding), but synthetic mordants now include acrylic resins, PVA emulsions, and numerous other non-lipid materials.

The main constituent of standard gold size was linseed oil, treated with driers (also called "siccatives"). Their use shortens the drying time by catalyzing the drying of oil-based materials via free-radical autoxidation of the oils with air. The speed at which the treated oil dries depends on the type of drier, the amount added to the oil, and the length of time the oil is heated with it. Other materials added to gold size included copal varnish (a heavy, dark fossil-resin varnish that promotes even drying) and sometimes Venice turpentine (a plasticizer that makes the size more flexible, and helps the oil size to form a continual film). Individual manufacturers do not release their ingredients' precise proportional details.

Oil-gilding size was traditionally made by leaving shallow trays of cold-pressed linseed oil to thicken in the sun. The addition of driers was necessary in the Northern hemisphere, while in Southern Europe, more sunlight allowed for faster drying/thickening processes (as mentioned in Cennino Cennini's Italian treatise, *The Craftsman's Handbook*).

Oil gilding is only successful, and stable, if the gold leaf is applied to the prepared oil-sized surfaces when the size is at exactly the correct drying tack during its drying cycle. Traditional oil size will have already completed part of its drying cycle when it is supplied; once applied to a prepared surface, it must dry further for successful gilding to ensue. If the size is too dry when gilding, the gold leaf will not attach and stick. Too wet, and the oil size will still be mobile under the gold and the film will move until drying is completed. Oil gilding on an insufficiently dry gold size eventually results in an unstable, dull, and wrinkled surface ("elephant skin").

Gold size is available in types designated by their drying times. The advertised gold size drying times on containers are only a guide, and are not prescriptive. A drying time refers to the theoretical time between when the gold size is applied to the prepared surface and when it has dried to the correct tack stage before being ready to receive the gold leaf. It does not refer to the time the gold size might actually take to complete its drying cycle fully. The designated size-drying number given on the oil gold size as sold is not to be used as a definitive measurement of when the gold should be laid after applying the size.

Gold size types include:

Japan: This oil gold size is the quickest drying. As a guide, it takes about thirty to forty-five minutes. It often has uneven drying characteristics, but it is useful for small areas, or for outside work that requires speedy application of leaf to small areas, to avoid conditions such as weather changes or dust.

One Hour: This gold size is commonly produced in clear or yellow varieties and can be ready for gilding less than an hour after application. The danger is that the quicker the size dries to gilding tack, the shorter the gilding window, so a size that dries to gilding tack in about an hour might allow ten minutes to gild before the size becomes too dry.

Three Hour: This oil size is less viscous than Japan and can take approximately two to five hours to dry. It is suitable for objects in which the design allows for sectioning area by area (perhaps lettering or section-designed objects); maintaining a "wet edge" when applying the size is only possible on small areas. Once it is tack ready, three-hour gold size may allow a window of perhaps thirty to forty-five minutes before it becomes too dry for successful gilding.

Twelve Hour: This oil size is commonly used for larger objects or architecture. It dries evenly and allows a working period, when tack ready, of at least four to five hours. This may be necessary when working over large areas. Nevertheless, it is common for size labeled "twelve hour" to take far longer than twelve hours between applying and gilding, and it can take up to eighteen hours or so.

Sixteen and Twenty-Four Hour: These oil gold sizes are infrequently used as they are harder to come by today. They are used on extensive areas of gilding wherein a twelve-hour size might dry too quickly with increased airflow, or more expansive environmental conditions may dry the size too quickly for a feasible working practice.

Synthetic Sizes: These types of sizes are water soluble until polymerization occurs during drying. They form a film very quickly (usually five to twenty minutes), but do not dry evenly, or gild evenly. It is difficult to keep a wet edge when using them, and only small areas are possible. The effect after gilding is less lustrous than that of oil sizes. PVA-based sizes remain indefinitely soft, and they are therefore considered unstable, inferior, and unsuitable for gilding.

Oil Gilding Preparation and Method

Preparation Based on Nature of Substrate

ON A GESSO GROUND

If using gesso as a ground for oil gilding, apply rabbit-skin size and silk to the bare wood, as with water gilding. Apply sufficient gesso to give enough depth to cover the grain and the thickness of the silk. Rub the gesso down to a smooth finish, with no marks or blemishes, then proceed as below.

ON ANY SUBSTRATE

If the support or substrate is porous (e.g., gesso, plaster), seal the surface, traditionally with two to three coats of thin shellac, such as Decol polish, and then leave to dry. Next, apply several layers of thinned oil-based eggshell paint to produce a yellow color base and a rich, smooth finish (between two to six layers is common). Rub down each layer when dry with fine abrasive paper (320 silicon carbide paper or finer). The paint layer *must* be oil based and preferably eggshell for a superior finish. Do not use water-based emulsions or oil-based topcoats as none of these have satisfactory working characteristics or yield successful results. Gently rub the final paint layer down to produce a blemish-free surface.

Oil Sizing

Old gold size was historically supplied as a deep yellow, for a color base compatible with the gold. However, oil size is now generally supplied clear, hence it is necessary to apply a separate yellow paint layer first. Test results on mixing yellow color into modern oil sizes showed that modifying gold sizes in this way was detrimental to their drying characteristics. Oil gilding needs this yellow underneath, for richness of color, and also to disguise any small faults that may occur in the gilding; ideally, oil gilding should not be patched, as it can show.

Apply the size evenly, with a flat sable or hogs' hair brush, using the minimum amount of size possible for complete coverage, with no gaps or "mean" areas. A thin layer of size will dry evenly and thoroughly; thick layers will drip, bruise, and wrinkle, causing unsightly and unstable gilding. Brush the size out thoroughly,

and ensure that no gaps are left uncovered; you cannot patch any lacunae easily. Work systematically across the gilding surface to ensure even coverage. You will be able to see where you have been, as the eggshell paint contrasts well with the shiny, saturated nature of the gold size.

Drying Times

Temperature, type of substrate, and airflow around the gilding will all affect the drying time of the size. All the sizes are ready to gild when they are touch dry, and the sized surface cannot be marked with a light fingerprint. The size should feel "rubbery" when gently touch tested. A traditional test was to touch the size with the hairs on the back of the gilder's fingers; when they just dragged the size, it was ready. A good test is to lightly run the little finger (which is more sensitive than the others) over the surface of a less prominent sized area, and if the surface "squeaks" or "clicks" it is ready to receive the gold. The longer the size-drying time, the glossier the gilding will be. Dust is detrimental, so work in a dust-free environment. Make a protective tent for the gilding if required (though not airtight, as the size will not dry).

Different oil sizes can be mixed together to control the drying times. With current global warming influence affecting even gilding work, in England a twelve-hour size is usually ready in perhaps eighteen to twenty-four hours so, if necessary, speed the time by mixing Japan gold (or three-hour) size with the twelve-hour size. This will shorten the drying time to about fifteen hours. Remember, the longer the oil size takes to achieve its optimum drying tack once applied, the greater the time span (the gilding window) in which to lay the gold leaf, before the size becomes too dry and is no longer receptive to the gold.

Oil Gilding: Applying the Gold

Leave the size to dry in dust-free, stable, and favorable conditions. When exactly the right tack has been reached, gild with either loose leaf or transfer leaf. If using transfer leaf, be careful not to press too hard on the tissue, as this may bruise the surface. Handle the loose leaf as with water gilding.

Loose leaf results in a better finish on anything in the round; transfer leaf is required for exterior working only, if gilding in situ. Always use loose leaf if working inside. Loose-leaf gold is more easily placed into hollows and recesses and is more malleable and more lustrous than transfer leaf.

If using transfer leaf (as was necessary in gilding the outdoor stage in Shakespeare's New Globe Theatre, London), make sure the correct "leaf pressing" type is obtained. This refers to the pressure with which the gold leaf has been applied to its handling tissue at the point of manufacture. "Loose-pressed" leaf is smoother gold, as less tissue texture is evident, but if gilding outside, loose-pressed transfer leaf may not hold to the tissue and may be mobile in fresh air.

Place the tissue (gold side down) onto the tack-ready sized area and rub gently over the back of the tissue to release the gold. If gilding large areas, use cotton, wool, or a soft cloth to gently release the gold, and to protect fingers. Overlap the gold leaves when positioning to ensure that no gaps are between the leaves. If oil gilding with loose leaf, use pieces of gold that are as large as is feasible for the surface contour as leaf joins may show. Apply loose leaf over the whole sized area before tamping down thoroughly, initially using a soft brush (squirrel mop or sable writer). Do not tamp as you go, as the loosened gold skewings can fly onto any surrounding tacky gold size, and this will then show when the affected area is gilded.

Unlike water gilding, start from the lower areas of the form first, and gild toward the top. This allows for any accidental leaf skewings to drop safely downward onto pre-gilded areas, and not onto active gold size, which may result in blemishes in the finished surface. Deliberately overlap the gold pieces to ensure that

there are no hairline gaps, and to make sure that the entire surface is covered. Gaps cannot be covered easily once the gilding is finally pressed and skewed off. Do not use gold leaf skewings to fill active size areas; the skewings will be oriented "end on" (in contrast to the areas of flat, beaten leaves), and will have a broken, bruised appearance compared to the adjacent molecularly flat beaten gold; the light will be reflected and broken in entirely different ways by loose-leaf gold and gold skewings, so the difference will show.

Once the entire sized area has been covered with leaf, gently press the gold down using a dedicated sable writer or squirrel mop. (Earmark a brush for this task alone, as otherwise residue in the brush might scratch or mark the gold.) Then use a silk "bob" by accurately and gently pressing the bob onto the gold with a careful rolling and lifting motion. Do not drag or wipe the bob over the gold: the oil size is still vulnerable to damage and bruises will show. Make a bob by putting a ball of cotton wool into the center of a square of fine silk and tying it at the top with thin thread to make a compact, hard ball, appropriate to the size of the areas you need to access.

Once worked over with the bob, "skew off" the gold with a soft sable, ox, or squirrel-hair brush, working the brush gently at an acute angle across the gold to lift any excess leaf. Breathe onto the gilding during skewing; the condensation can then be brushed away gently, picking up any tiny gold skewings and leaving a clear, smooth, and reflective surface. Traditionally in oil gilding, very hot water was poured over the newly gilded surfaces to settle the leaf and harden the oil size. This is not recommended as it can result in much damage.

Pure 24K gold should be used if the oil gilding is in an exterior location. Any alloy that might be added to change the gold color lowers the gold purity (karat), and may result in oxidation (tarnish), especially if the gilding is located in areas of high pollution or sites exposed to weather extremes (e.g., outdoor sculpture or sun dials). It is advisable to use double-thickness gold leaf to prolong the life of exterior oil-gilded surfaces.

The gilding must be left for a few days or longer to harden properly; otherwise bruising may occur when handling the object. Freshly gilded oil sizes will still be relatively soft, and will need time to complete their hardening processes. The longer the time between sizing and gilding, the longer the finished gilding must be left to settle before handling.

The new oil gilding in Brighton Pavilion's Music Room (following a disastrous fire), which used a mixture of twelve-hour and Japan gold sizes, was left to harden through for three months before further glazing processes and handling.

There is no need to seal the gilding unless colored gold has been used; the color is due to alloys being present, which will oxidize and darken if unprotected. Protective coatings may also be needed in rare and specific exterior locations (e.g., figure heads on ships). Outside of these cases, there is no need, as the gilding is likely to survive outside longer than a protective coating.

TONING AND DISTRESSING GILDED SURFACES

Context, Terminology, and Factors Affecting Appearance

Context

It is important to remember that for millennia gilding was seen in natural light, firelight, or candlelight. All of these light sources made gilded surfaces appear magical and sparkling, even in low light. The emphasis was on the glitter and depth of the surfaces, which lent a sense of awe and richness. The historic application of film-forming materials over the gilding, in conjunction with the introduction of textures in gesso, accentuated the reliefs and depths of the carved form, and gave the gilded surfaces more deeply reflective qualities and nuances. Period gilding was always solid and lustrous; the effect appealed to the desire to display wealth, beauty, and power.

The effect of modern artificial light on gilding is completely different from that which came before. Clearly, gilding seen by the light of a flickering candle will not have the same impact as gilding seen under LED, fluorescent, or spot lighting. Artificial lighting radically alters the lively effect of water gilding, and makes gilded surfaces appear brighter, flatter, and more brash. This affects the way we inherently perceive the impact of gilded surfaces now, and it subsequently impacts how we might approach the final stages in current gilding processes.

Toning

Period gilding has acquired a patina of wear, dirt, and natural aging of the gilding materials, which is seen today as adding to a gilded object's intrinsic beauty and effect. Historically, the gilding process was completed by judicious application of toning layers of film-forming materials to accentuate the effect of matte and burnished areas, to enrich the gilding, and to heighten the object's depth contrast. Toning is the deliberate application of coatings or matting agents that selectively soften the look of a newly gilded surface, or that latterly can match or retouch an area of new gilding to give integrity to an older piece.

Distressing

The mechanical wear gilding undergoes due to aging results in surfaces that, to our modern sensitivities, can impart nuances of historic richness and a sense of subtlety of surface. "Distressing" is the technique of mechanically emulating the wear gilding acquires with age, physically removing an amount of gold to imitate natural wear.

"Toning," as described above, adds film-forming materials to the final gilded surface to enhance it. The technique of distressing, which removes the gilding by degrees to emulate the natural wearing away of the surfaces over time, never formed part of historical gilding processes: why would the original client commission gilding to impart splendor, then subsequently allow the gilder to deliberately wear the gold away? Distressing new gilding artificially wears exposed areas to appear as if they may have naturally worn away over their history, through repeated handling and dusting.

Water gilding and oil gilding deteriorate with age in very different ways. Historical toning layers alter in specific age-related ways, perhaps by darkening, becoming brittle, contracting, or trapping dirt within the coatings. These aged layers are then susceptible to any ensuing mechanical wear, such as abrasion from dust, feather dusters, or other means of mechanically removing materials. What we see now on a historic gilded surface is the age-deteriorated original toning (if it has not been cleaned away along with entrapped dirt), coupled with the abrasive wearing away of those surfaces, including loss of any toning, gilding, bole, and possibly even erosion through to the white gesso and wooden substrate.

Taking a purist approach, after completion of a new gilding process it is theoretically only necessary to apply toning layers of the chosen film-forming materials to complete the visual effect of new gilding. However, current lighting types and sources, and modern visual sensibilities, may require the gilding to be distressed, wearing it away to lessen the bright "newness" of the freshly gilded surface. If distressing of a newly gilded surface is the chosen option however, it must be undertaken after gilding but before toning layers are applied, the opposite of the natural process of historical techniques. While aged period coatings become hard enough to wear away naturally over time, new toning coatings, even after their film-forming stage, do not have the same nature as aged coatings and are likely to be too soft to be abraded for an effect similar to an aged period coating.

Factors Affecting Gilding Appearance

Gilding trends and fashions have influenced how gilding may have originally looked during certain time periods. Historical use of different bole colors throughout the ages is a primary factor contributing to the difference in appearance between the gilding of one period (e.g., the dark red bole prevalent in the Italian Renaissance) and that of another (e.g., the pale gray bole common in the English Regency period, as seen in Brighton's Royal Pavilion).

While the thickness of gold leaf has changed throughout history (becoming thinner), most regular gold leaf allows some transmitted light through to the underlying bole colors (see "Bole"), and eventually the reflective white gesso. The underlying colors have an effect on the appearance of the gilding. Aged gilding will intrinsically reveal the underlying bole color or colors, giving a characteristic appearance to particular periods of gilding.

The treatment of the finished gilded surfaces also changed from one period to another. English Victorian gilders liked to cover the gilding with a coat of thinned shellac before applying matting coatings and/or color (e.g., using rabbit-skin glue and pigment or colored natural resins). Louis XIV gilding looks very even and flat by comparison, due to the use of minimal color over the gold and delicate matting in restricted areas. The eighteenth-century English maker Matthias Lock and the English Chippendale school are now associated with gentle rubbing through to the bole and light-colored dusts carefully applied in the hollows, although distressing was never part of the original, historic eighteenth-century gilded finishes.

Popular modern trends may expect the gold to look either almost worn away or "old but in good condition," but not to look "restored." It is very difficult to judge just how far toning and distressing should go, unless you are actually retouching missing areas in originals in which the extant surface finish can be matched. Owners of gilded pieces may not appreciate that current perceptions are not always compatible with what may have been the original finish. The Music Room at Brighton's Royal Pavilion was restored to its original Regency brilliance, which may not suit all current gilding tastes, but it has complete integrity in its period context.

Methods and Materials

Chosen methods of toning and distressing were once closely guarded secrets, even now held by some older gilding workshops and practitioners as being their own "specialties." Apprentices were sworn not to reveal the workshops' methods and materials. (These often included striking the gilding with a rusty chain; flash-igniting alcohol on the reverse of a frame to darken it, conceal alterations, and impart age; or swamping gilding with washes of heavy admixtures of noxious colored coatings, often tea and coffee, which would then be wiped away, both leaving deposits in the hollows and removing the high-point gilding.) As late as the 1950s, the National Trust in England was applying washes of heavy, oil-based, dark-brown toning mixtures to seventeenth century furniture that was originally water-gilded to emulate age (e.g., the re-gilding on James II furniture at Knole House, Kent, England). Needless to say, this has had a disastrous effect as those inappropriate materials have aged badly.

There are no "magic" materials, recipes, or techniques; it is the integrity, skill, and dexterity of the gilder/practitioner that will produce rich, subtle, complex, and stable surfaces, and not the material itself. If a good knowledge of materials is coupled with professional standards, humility before the object, and sensitive integrity, the gilder is basically free to use a wide range of acceptable materials to achieve a desired effect that will not be deleterious to the gilding in the future.

After gilding, the object should be left to rest for a period of time. Fresh water gilding remains reactive, even if it feels dry for some weeks after completion. If possible, distress and tone water gilding a few weeks after gilding. (There is no minimum or maximum time; it is just a precaution.)

Leave oil gilding for as long as possible after applying the gold, to allow the oil-based films underneath the gilding to fully complete their drying cycle and harden thoroughly. The time depends on the type of oil-based gold size used, how thinly it was applied, and when it was gilded during its drying cycle. This could be anything between a week and a few months. (Think of varnishing an oil painting; it takes time for touch-dry oil-based layers to be fully dry throughout their depth, and thus safe to apply a film-forming varnish coating.) Oil gilding was never distressed as part of its process, although period oil-gilded surfaces do now have a visible degree of wear, facilitated by the hardening over time of the toning coatings originally applied, which have worn away naturally through aging processes.

Generally, water-based materials were used historically to tone oil gilding, and oil-based materials were used for water gilding. In practice, there is much analytical evidence for both "families" of materials having been employed on both types of gilding. The choice was at the discretion of the gilder, allowing for the vagaries of the workshops' guarded secrecy in their manufacture and use of specific toning mixtures and materials.

Lighting in Working Environment

Always distress and tone gilding in natural, even light (not in strong sunshine). Artificial light reflects gilding too much and gives a false reading of the levels of distressing and the colors and impact of toning. The metamerism effect is especially problematic with gilding: the coatings and colors appear different from one viewing angle to another, so a subtle layer in one light may look alarmingly dominant and obtrusive in another, or look out of place if viewed from a different angle. Creep slowly and gently toward the final finish desired. Ideally, undertake the distressing and toning stages over a period of time to allow for fresh visual appraisal as you progress.

Choice of Materials

Gilding conservators are aware of the core necessity to make educated choices in the use of stable and re-treatable materials with known aging characteristics, as well as the desired characteristics in handling and use. It's no good having a perfect toning material in every respect except its ease of application on a gilded surface. In a commercial workshop, cost may also have an impact: for specific projects the use of suitable, excellent, but very expensive materials designed for the conservation discipline may be prohibitive. Fundamentally, it is imperative to balance and to justify the use of chosen materials and their innate characteristics within the context of the project at hand. Each project is individual, and as such may need bespoke systems and materials. The shocking or disappointing conclusion to all the above information, discussion, and notes is that there is no generic toning and distressing material or method. However, in order to forward the discussion, the materials and methods below are suggestions only; there are many more methods and materials available to employ.

Some Methods and Materials for Distressing

Ensure appropriate health and safety precautions are taken, including Personal Protective Equipment as required. (Please note that recent oil gilding should not be distressed, as the new oil size is too soft to allow it.) On water gilding, undertake the distressing (rubbing through) first. Work gently, as it is easy to go too far and remove too much gold. The working areas are those that would naturally receive wear: the tops of moldings, edges of carvings, and uppermost protrusions. Materials may include (not in order of preference):

Grade 0000 Oil-Free Steel Wool: Use as small hand swabs or mounted on a swab stick for precise areas. Steel wool will abrade very quickly. It should be used judiciously, and certainly in good light. Work in a haphazard way, as scratches and striation lines are unwanted. Ensure that the surface is thoroughly vacuum cleaned afterward using a protected dry brush after distressing, as any remaining swarf may rust or cause a hazard.

Fiberglass Propelling Eraser, or Graded Metal Filings Bound in Varying Hardness of Rubber: These allow fine control, but care is needed as the compressed fiberglass strands are a serious hazard. These are not commonly used anymore. It is preferable to use the rubber-bound metal filing blocks, which work well in controlled, tight areas where blending is required. They can be cut to shape and used easily and gently for small areas.

Pumice Powder: Pumice powder is efficient for distressing. It should be used dry on a fine cloth over a finger or on a cotton wool swab for blended areas, or on a cloth over a shaped eraser for control. It has strong abrasive qualities on its own but is miscible with finer abrasive powders (e.g., French chalk or rottenstone to lessen abrasion and allow more control). It also imparts color to the gilded hollows if rottenstone (dust colored, dark gray) is added.

Rottenstone: Fine abrasive/polishing powder. Gray color is similar to natural dust, so it is sometimes used over newly gilded carvings to "settle" the surfaces. As described in "Pumice Powder" glossary entry, use mixed with pumice to abrade more quickly.

French Chalk: As with rottenstone: fine abrasive/polishing powder; white. Use dry; very gentle effect.

Burnisher: There is some risk to the gilding as extended burnishing may eventually result in the bole com-

ing through, or in the entire gilding/bole system exfoliating through overcompression. If this is the chosen method, use an old burnisher, as progressive use may dull an active agate's polish.

Old, Stubby, Damp Hogs' Hair Brush, or Damp Silk Rag: Materials used depend on the effects desired, and the preference of the gilder. Dry methods are usually considered safer and more controllable than wet materials, but damp techniques may be used judiciously. Water will soften and dissolve water gilding, and can draw the glue up to the surface, resulting in weaker adhesion in the underlying gesso and bole layers. If water is used too copiously, this may cause future delamination. Use brush or rag moistened with minimal water, sufficient to feel barely damp.

Some Methods of Toning

TRADITIONAL CONTEXT

Toning is either the application of a colorless glaze over the gold to matte the surface and make the gold flatter or more even, or the application of a thin film containing color in order to enrich and emphasize depth in the form. The colored layer is traditionally pigment held in the medium opposite to that of the gilding technique used, that is, water gilding traditionally used oil-based colors, and oil gilding traditionally used watercolors.

With care and practice, toning water gilding with water-based materials is effective and should not endanger the water gilding if used correctly.

ISOLATION LAYER

It can be considered necessary to apply an "isolation" layer between the gilding and subsequent toning layers, to allow for safer use of several materials on the same area. This may be a film-forming material that will not react with subsequent coatings, and that will not, in turn, affect the underlying gilding system. Historically, it could include a weak film of shellac. The use of very thin Paraloid B72 acrylic co-polymer became common during the twentieth century and is still in use. There are now several conservation-designed film-forming materials that may be used, which are specific to personal preference.

Toning layers can be applied in various ways:

1. As a wash: thin the coating material down with appropriate material and apply as a subtle wash. Use a dry brush (a flat badger brush is best) or sponge to even out the surface afterward.
2. Stippled on: use the film-forming material quite dry, and work the brush gently into hollows and undercuts. Remove excess color with a cotton wool swab, sponge, or soft dry brush.
3. Sprayed on: use a fine airbrush. Not as controllable as above but may give more even coverage on larger projects.

TONING MEDIA

The nature of the gilding in the context of the object should suggest appropriate toning materials according to the final effect desired (after any required distressing has been achieved on water gilding).

TRADITIONAL AND ALTERNATIVE MATERIALS

Traditional toning materials have included animal and vegetable resins; gums; proteins such as parchment, rabbit skin, or gelatin size; ormolu (a weak form of shellac); gamboge (a natural yellow resin); dragon's blood (a red vegetable resin); and many other materials used in combination or in successive layers. The traditional proteins, gums, and resins historically used now comprise further media for carrying toning

pigment, or if used as clear coatings, for altering the light refraction and therefore the look of the gilding, as required.

- Basic watercolor: gum arabic plus pigment, more readily available as the pre-made artists' product.
- Artists' oil colors: better used from the tubes, as they are uniformly finely ground (though they are slow drying and may be unstable, so not preferable).
- Shellac: commonly used in the nineteenth century, with or without the addition of pigment. Thinned with alcohol, it was used to "even out" gilded surfaces. Has the disadvantage of cross-linking, discoloring (brown), and contracting, possibly pulling up gold underneath and forming darkened mosaic "islands," particularly prevalent on oil gilding.
- Pale shellac: for gilding, traditionally called "ormolu" (please note: not to be confused with the same term used for mercury-gilded metal furniture mounts). It was added to hot rabbit-skin glue, stirred with an expendable brush to "combine" the resin and the glue to produce a pale, milky brown film-forming material. Used to visually "flatten" and even out surfaces. It was also used traditionally as an isolation layer (see "Isolation Layer" above).
- Microcrystalline: popular in the twentieth century. A paraffin-based wax, mixed with 25 percent polyethylene wax (commercially sold as "Renaissance wax"). It was diluted in white spirit, and was used on its own to matte a surface prior to polishing it, or used in conjunction with a "pounce bag" (a muslin bag filled with rottenstone, French chalk, and pigment). A thin layer of the soft wax was applied in the hollows and lightly dusted over with the pounce bag. Excess "dust" was lightly brushed away when the wax was hard. (Lefranc Bourgeois's "céronis" varnish was similarly used.) If wax was used at all, it was applied as the final layer, as further coatings would not adhere.
- Paraloid B72: acrylic co-polymer resin taken down in solvents including acetone/IMS. This is considered to be one of the most stable synthetic resins available. Can be used with or without pigment. Useful as an isolation layer when applied as a very thin film.
- Primal WS24 (now replaced with alternative acrylic dispersion): acrylic dispersion. Originally used as a bone consolidant. Supplied in water, the acrylic needs further thinning with water, in the range of 1:3 or 4 parts resin to water, or even greater dilution. It polymerizes, thus it is not re-soluble in water when dry, so it is useful for building up toning depth in thin applications without re-dissolving previous layers. Miscible with watercolor, dry pigment, or artists' acrylic paints.

Other conservation-grade materials (e.g., film-forming materials such as Laropal A81) may be used, and there are numerous other conservation-designed materials and applications. It is important to understand the nature, characteristics, and stability of any material in order to have knowledge of potential interaction with other materials before using.

It is vital to build up thin layers gently, and to reevaluate progress at each layer, as it is easy to go too far in toning the gilding and apply too heavy a coating. Do not lose the contrast between any burnished and matte areas, as otherwise you defeat the purpose of water gilding.

Finally, ensure that you have documented thoroughly what you have used, and how you have achieved the result. It may be helpful to paint out the colors of boles used on white paper, and to add the various layers of toning you may have applied; you can never have too many samples for future reference.

CONCLUSION: KEEP LOOKING

Keep looking at every gilded surface you can find. Really look. Seek out the clues: the gilded object's context; any damages revealing the support and ground; the depth, saturation, or aging characteristics of the layers; the bole's nature, colors, and wear, perhaps revealing its method of application; the gold type and characteristics. Find the edges of the leaves to see exactly how the gilder laid the leaf at that moment in time; notice the depth and tooling marks of any gesso cutting (evidence of that heartwarming personal connection with a craftsman from another time), and any damages or even original bubbles in the period gesso. Discern even the gesso's glue/whiting balance just by noticing the saturation, wear, and effects of time. Keep looking!

Use what you already know to interpret what you find, and nurture your visual awareness; search for ongoing evidence of materials and techniques in the things you see before you, to increase your craftsman's instinct and knowledge in order to understand and interpret what you see, to find intimacy with the object, and to connect with the person who made it in a different time. Honor their skill, craftsmanship, and understanding.

It is through practice, experience, and ever-increasing respect and passion for gilding that professional and sensitive results can be achieved. What a privilege we have in our knowledge, understanding, and love for our field, and in our intimate connection with all the many master-craftsmen gilders of previous centuries.

Glossary

Bole: Colored clay mixed with protein glue and applied over gesso; allows good base for burnish after water gilding.

Composition: A mold-filling material made popular by Robert Adam. Pliable when warm; hardens on cooling. Pressed into reverse-carved molds.

Distressing: The artificial wearing away of new gilding to imitate a period patina resulting from age-related abrasion.

Gesso: Ground for water gilding or panel painting. Made from whiting and protein glue (usually rabbit-skin glue and chalk in England).

Glaze: Translucent coating applied over paint, gold leaf, silver leaf that changes the appearance of, or protects, the layer below. Colored or clear.

Ground: The intermediate layer between the support and the gilding (e.g., the ground atop a wooden support could possibly be gesso or paint).

Luster work: Translucent colored glazes over gilding/metal that give a reflective, deeper metallic effect to a finish.

Mean: The amount of gold size brush-applied over the given oil-gilding area; too little gold size applied. If the gold size is brushed out too thinly, or is over-brushed, the resulting area may dry too quickly compared with other sized areas, or not have enough size there so the gold leaf won't attach.

Mordant: An intermediate material allowing one layer to attach to another (e.g., oil size between a paint preparation and gold leaf).

Oil size: Linseed oil-based film which, when applied and dried to correct "tack" stage, is the mordant for gold leaf in oil gilding.

Pigment: Pure mineral, metallic, earth, or synthetic coloring matter, without any medium or filler; pigment plus binding medium equals paint.

Pipe clay: English ingredient for bole, rarely used now. Geological strata below coal; once the soil in which trees that are now coal grew.

Rabbit-skin glue: Dry protein glue sold as powder or granules, diluted in water and heated for use.

Rabbit-skin size: Dry protein glue swelled into water, then warmed up to form a very thin hot glue, in a ratio determined by the required gel strength.

Size water: Weak rabbit-skin size plus water and alcohol used to wet the bole prior to water gilding with loose leaf.

Support: The base over which gilding is applied (i.e., wood, plaster, metal).

Toning: The application of film-forming materials over gilding. Colored or clear. Alters the look of gold, or matches new with old. Often an original period finish itself, applied as part of historic gilding processes.

Wagon: Parallel-bladed cutter-tool that cuts the rough-edged beaten gold into the finished beaten squares before transferring into the books of leaf. It comprises two straight-sided, sharpened bamboo blades held parallel at 3.25 in. apart by right-angled wooden elements, with a handle attached across the top. When it is used, the gold is cut with two parallel blades in one orientation, then the tool is repositioned at 90 degrees to make the final cuts in the rough-edged leaf, producing a square gold leaf to be moved to the tissue books prior to sale.

Whiting: Inert white powder combined with glue in making gesso. Northern Europeans generally use chalk whiting (calcium carbonate); Southern Europeans generally use gypsum (calcium sulphate).

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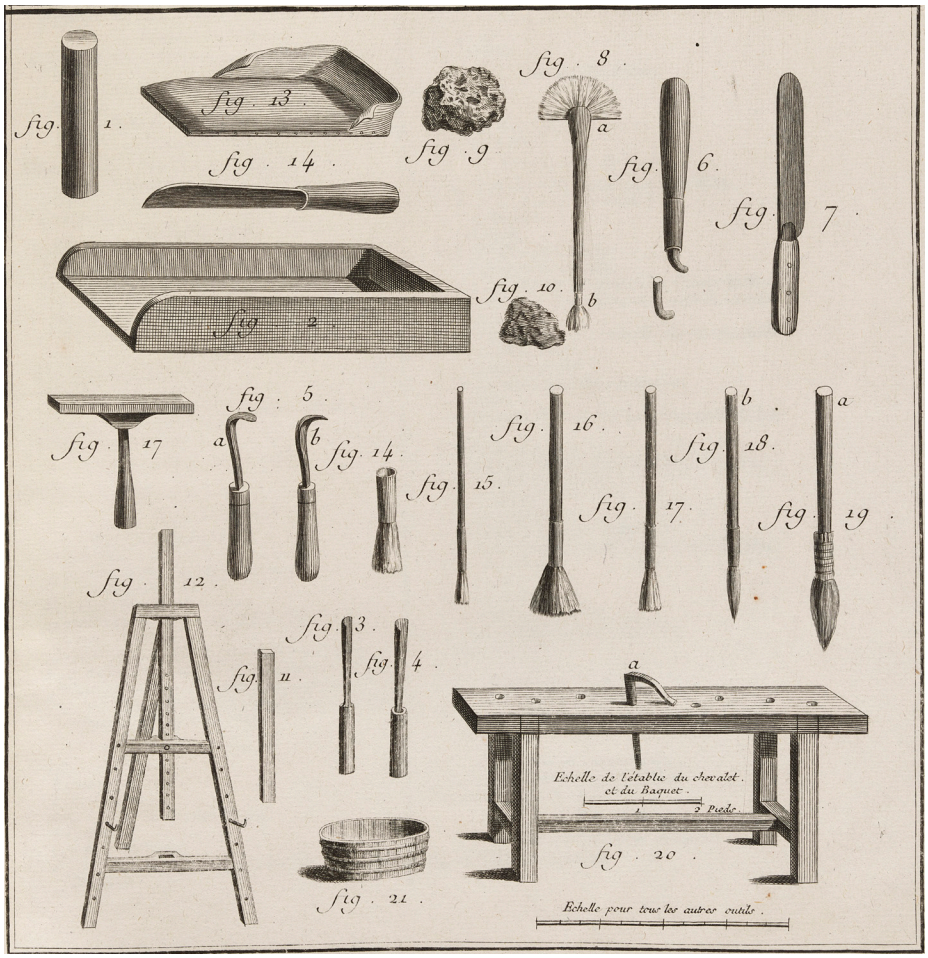
About the Author

Following graduation from Brighton Polytechnic and the conservation course at the City & Guilds of London Art School, Judith Wetherall, Accredited Conservator-Restorer (ACR), specialized in gilding, japanning, and period paint, studied in Italy and Germany. She then received a Winston Churchill Travelling Fellowship to study the conservation of gilding and decorative period paint on architecture, furniture, and frames. She became self-employed and ran her workshop for more than forty years. During this time, she worked at a variety of locations on a multitude of projects: the Brighton Pavilion for a ten-year project on the fire-damaged Music Room gilding; numerous National Trust properties on gilding, decorative art objects, and furniture; museums and other heritage bodies and collections, including the Wallace Collection, Historic Royal Palaces, the Victoria and Albert Museum, the Burrell Collection; cathedrals including Lichfield, Worcester, Westminster Abbey, St. Pauls, and numerous churches. She also researched, developed, and carried out the gilding and painting on the new Shakespeare's Globe, among numerous other public and private commissions involving both conservation and new work. She worked part time at the Guildhall Art Gallery, London, for seven years as a frame conservator, and as a conservator in the National Trust's new conservation studio at Knole, Sevenoaks, England.

Concurrent with her freelance work, she taught gilding, period paint technology, and japanning at the City & Guilds of London Art School for nineteen years and has taught at West Dean College of Arts and Conservation on all levels since 1991. She has also enjoyed lecturing for the Institute of Conservation (ICON), adult education, and numerous universities and groups. She has written, published, and edited many conservation-related works, and revels in researching traditional practices to then develop and apply innovative methods and techniques, in order to advance the field of gilded surfaces. In 2015 she was awarded the Radcliffe Trust's Lord Balfour of Burleigh Tercentenary Prize for Exceptional Achievement in Crafts. She was an early member of the United Kingdom Institute for Conservation of Historic and Artistic Works (UKIC) in its founding years and, until retirement, was an ICON Professional Accreditation of Conservator Restorers (PACR) assessor.

FIGURE 13 The author's reproductions of eighteenth- and nineteenth-century table swags—her first woodcarving and water gilding exercises when she was in college.



White-crushing roller (fig. 1), White-crushing board (fig. 2), Repair gouge (fig. 3), Other repair gouge (fig. 4), Repair hooks or irons (fig. 5), Sanguine (fig. 6), Gold knife (fig. 7), Palette with brush (fig. 8), Pumice stone (fig. 9), Sponge (fig. 10), Easel bench (fig. 11), The easel (fig. 12), Pad (fig. 13), Other gold-cutting knife (fig. 14), Sanding brush (fig. 15), Bleaching brush (fig. 16), Small bleaching brush (fig. 17), Vermilion brushes (figs. 18 and 19), Workbench (fig. 20), Bleaching tub (fig. 21).